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Innovative Information Technologies

Part III

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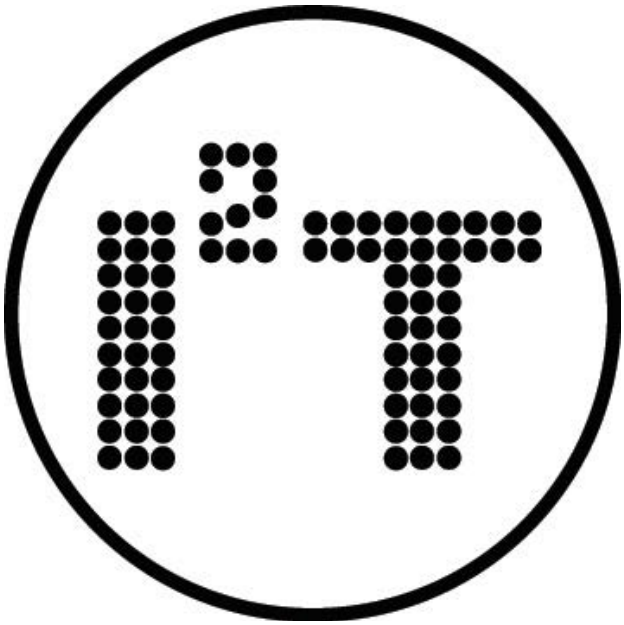

PART 3
INNOVATIVE INFORMATION TECHNOLOGIES IN INDUSTRY AND SOCIAL-ECONOMIC SPHERE

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The materials of The Third International Scientific – Practical Conference is presented below. The Conference reflects the modern state of innovation in education, science, industry and social-economic sphere, from the standpoint of introducing new information technologies.

Digest of Conference materials is presented in 3 parts. It is interesting for a wide range of researchers, teachers, graduate students and professionals in the field of innovation and information technologies.

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Section 3
INNOVATIVE INFORMATION TECHNOLOGIES IN INDUSTRY

A METHOD FOR RECOGNIZING INDICATIONS OF ARROW INDICATORS

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Examples of systems for which the actual using of arrow indicators is reviewed. Disclosed stages and described by the mathematical apparatus of the proposed method. Are examples of recognizable images is presented. The estimation of the computational complexity of the method is given.

Key words: recognition of images, video camera, display, telemetry.

Despite the widespread use of electronic sensors with digital indicators, in some cases there is a necessity of registration of parameters of mechanical sensors [1] with the arrow indicators [2]. So, for example, electronic sensors fluid flow is significantly cheaper than mechanical. Known magnetic compass with remote telemetry scale image transmission rate (patent RU 2441201) used in the navigation instrumentation [3] and other.

The task of telemetry [4] in such systems can be addressed through a cheap video camera focused on the display of the sensor.

In the General case, the camera produces an image size of elements (pixels) [5]. You want the mutual arrangement of the indicator and the camera in the process of work has not changed.

The existing method of recognition of indications dial indicators [6] developed by Russian scientists, gives inaccurate readings and does not take into account the vertical and horizontal testimony of the arrow.

The method consists of the following stages:

1) Background Removal.
2)Binarization.
3) Morphological filtering.
4) Finding characteristic points.
5) Calculation of the needle and indicator.

Initially producing object division (arrows) and the background (the scale) based on two images, where the arrow is in two different positions, read, image J^1 and J^2, and get a background image by the formula

$$I^B = \max\left(J^1, J^2\right),$$

if the scale of the lighter the arrows or the

$$I^B = \min\left(J^1, J^2\right)$$ otherwise.

Options for selecting the background (scale indicator) figure 1 illustrates.

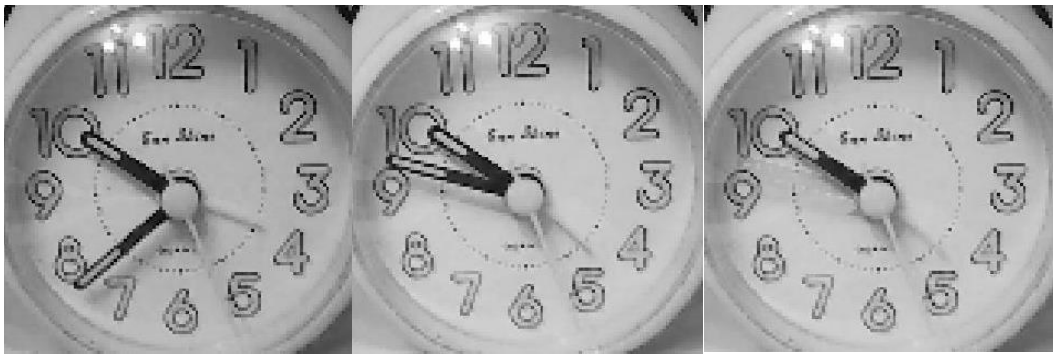

Fig. 1. The selection of the background (the scale indicator): a, b - image with different positions of the arrows; in the background is selected by taking the maximum of a and b.

Then read each image I^1 is subtracted background, take the absolute value and produce бинаризацию comparing the result with a given threshold Δ:

$$I^2 = \sigma\left(\left|I^1 - I^B\right| - \Delta\right),$$

where σ - Heaviside function.

Then to the result of the applied filter that destroys small (incomplete dimension) and the reducing small-size (small steps) artifacts binary image, which could arise due to the small displacements of the camera, small changes in the background, or malfunction of certain pixels. A filter is a composition of dilations and erosions:

$$I^3 = \left(dil \circ ero^2 \circ dil\right)\left(I^2\right),$$

where dil and ero respectively dilation and erosion with square primitive 3×3.

First dilatation increases with the main object, then double erosion destroys artifacts, then dilatation compensates the damage to the borders of the main object. Since the number of dilatations equal to the number of erosions, the primary object (arrow) in General does not change.

The binary image with artifacts arrows and background and outcome of the filter operation is illustrated in figure. 2.

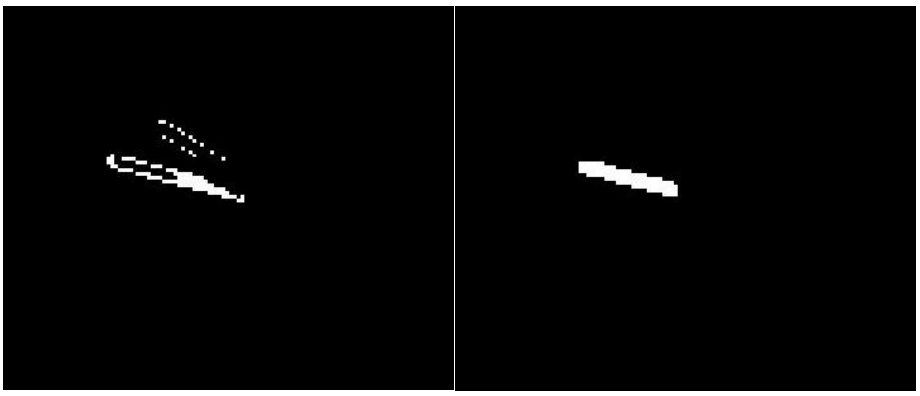

Fig. 2. The binary image (a) with the artifacts of the arrow and background the effect of applying a filter (b)

Let be $D = \left\{(i, j) \mid I^3_{i,j} = 1\right\}$ – a lot of white pixels in the image I^3. Calculate the mass center of this image:

$$u_0 = \left[\frac{1}{N} \sum_{(i,j)\in D} i \right], \quad v_0 = \left[\frac{1}{N} \sum_{(i,j)\in D} j \right],$$

where $N = \sum_{(i,j)\in D} 1$.

The image is divided into four quadrants with vertices at the center of mass and take the intersection of them D:

$$\{1,...,m\} \times \{1,...,n\} = \coprod_{s=1}^{4} K_s \coprod C,$$

where $K_1 = \{i < u_0 \wedge j < v_0\}$, $K_2 = \{i < u_0 \wedge j > v_0\}$, $K_3 = \{i > u_0 \wedge j < v_0\}$, $K_4 = \{i > u_0 \wedge j > v_0\}$, $C = \{i = u_0 \vee j = v_0\}$.

Now calculate the center of mass of each part of an image $D_s := D \cap K_s$:

$$u_s = \left[\frac{1}{N_s} \sum_{(i,j)\in D_s} i \right], \quad v_s = \left[\frac{1}{N_s} \sum_{(i,j)\in D_s} j \right],$$

where $N_s = \sum_{(i,j)\in D_s} 1$; $s \in \{1,...,4\}$. The ratio $N_s / N =: w_s$ is considered the «weight» of the point (u_s, v_s).

Thus, from the source image $m \times n$ pixel receive 5 points - the centers of mass of the different parts of the image. This procedure is a grouping of pixels with the use of a consistent and robust statistics (arithmetic average) and significantly reduces the complexity of the algorithm of finding the angle of the arrow (by 3-4 orders of magnitude when the typical values m, n).

The angle of the arrow estimate the angle of inclination of a straight line, approximating the obtained set of the centers of mass, based on weights. Angle translate into physical value displayed by indicator, using the given scale of the instrument (linear or nonlinear). Fig.3. illustrates this procedure.

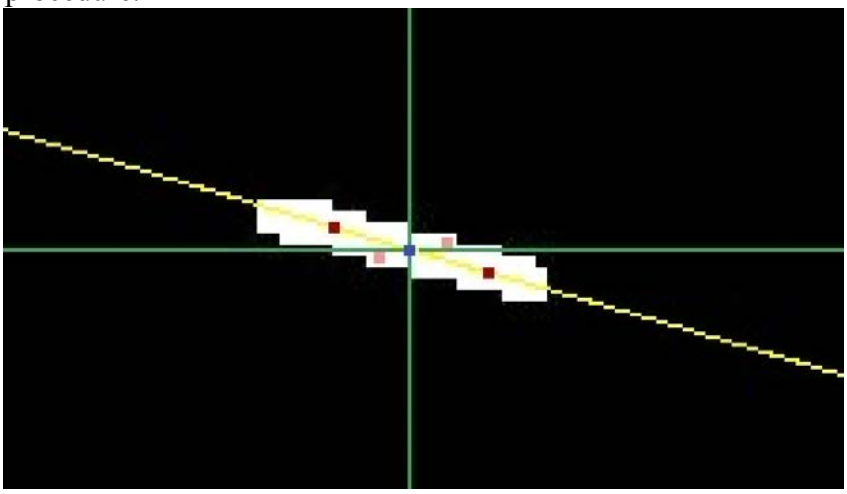

Fig. 3. Finding the angle of the arrow.

The blue dot to the center of mass of the entire image, green direct - borders between the quadrants, the red dots centers of mass of quadrants with more weight, pink dots - the centers of mass of quadrants with low weight. Yellow direct specifies calculated the direction of the arrow.

The above mentioned algorithm is applicable for any type of arrow indicators with any types of arrows. So, for line indicators (scale - cut) is enough to calculate the only center of mass of the arrow, and for секториальных and circular indicators (scale sector or circle) to calculate all five centers of mass. Arrows some indicators have shank, which leads to incoherence set D of points of the arrow on the image I^3. On the performance of the algorithm is not affected.

Counting the number of operations algorithm gives an estimate of the amount RISC instructions $50 \cdot m \cdot n = O(m \cdot n)$. When the typical values of parameters $m = 240$, $n = 320$, f=30 Hz, the required performance processor is about $30 \cdot 50 \cdot 240 \cdot 320 = 115$ MIPS. Thus, the algorithm in real time can provide RISC microcontroller with a clock frequency of 100 MHz and a capacity of about 115 MIPS (for example, ARM7 or Cortex-M3).

If a set of arrow indicators grouped into the dashboard, it is possible to carry out their telemetry module. To do this, all your indicators should get in the view of one video camera and resolved it. In this case, the pre-allocated in the image corresponding to each indicator. The recognition algorithm is performed separately for each selected area [7, 8].

The method can be implemented both in the form of a program for the computer and microprocessor or FPGA as an additional module, pluggable in the transmission path of the digital stream from the camcorder [9-11]. It is also theoretically possible option reprogramming (finalize) firmware camcorder for direct receiving numeric values reading.

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ACTUAL PROBLEMS OF BUILDINGS AND ROOMS PROTECTIONS FROM STRONG EM FIELDS

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The problem of buildings and rooms mounted electronic equipment protection from strong EM pulse is considered. Special buildings design tasks are listed and main trends are pointed.

Keywords: EM protection, shielding, information security

If external EM field level is sufficient, building mounted electronic equipment failure, data violation or in some cases physical damage of equipment are possible. The effective protection against premeditated and unpremeditated strong EM pulse (EMP) is required [1].

Information security has the highest priority. Secret data must be protected from unauthorized distortion, removing or damage by any way including EMP. Critical citizen and military telecommunication objects are implemented as special purpose buildings. The base electronic systems protection methods must be implemented. They are shielding, RF interference filtering, grounding, shielded zones. It requires integrated approach.

In last decade EM protection requirements for telecomm objects are mandatory for special purpose buildings design. This feature is closely connected to electromagnetic terrorism threats, high critical information security requirements, high EMI vulnerability for the high speed electronic systems and highly developed local networks. EMI shielding and integrated approach requirements mean, that not only electronic engineers, but architects and builders must know EMI shielding constructions design and test methods.

It after tests building design revision will be needed, then tests will be again need to conduct. It makes building more expensive and prolongs design period. It confirms, that scientific based building design references need to be used. This references increases building quality and minimizes risks, that EM shielding features will not meat specifications.

Special purpose building design involves specialists in various fields. This problem solving requires integrated approach, clear coordination and high qualification. Project, EM shields constructions and test methods design need to be conducted by EMC engineers and information security engineers. Specific architecture and building tasks need to be conducted by architecture specialists. But all that specialists in one of this fields must to have qualification in other of these fields. Higher school did not training this integrated qualification specialists. This factor influences to actual projects supply, which is highly demand.

The necessity of EM protection expanded as to EM problems, so to equipment protection. This equipment variety is beyond military and civil EMC applications. Because there is no developed EM shielding theory for building constructions, technical solutions are often expensive, because they are excessively, or have sufficient disadvantages, which violates fundamentals of EM shielding. EM shielding references developing is necessary by this reason. This reference provides basis of various effective shielding aspects to developer. Effective shielding developing specific tasks are following:

- material selection. This materials must provide effective EM shielding and meet constructive requirements, depending on application.
- construction and shields element connection methods, which provides minimal shield discontinuity.
- heating, ventilation, and air conditioning and power supply inputs design.
- EM protected access control systems and equipment transporting systems design.
- test methods select and implementation. Test methods must provide data to check EM protection requirements.

Shielded rooms design theory and practice for special purpose buildings can be considered as new trend: architecture shielding.

General shielding concept provides setting up one or more obstacles in form of metal shields on EM wave way from interference emitter to receiver. Global protection is desirable when it is need often to move or remount sensitive equipment inside shielded area. The fallback of global shielding is function conditions dependency for entire system from shield elements quality (shield, filters, grounding). If one of these elements is interrupted, entire system failure is possible. Shielding by zones is alternative to global shielding. Several EM protection lines are applicated. Is the general description of integrated shielding system. It convenient to describe this system as topological model. It is need to match system configuration with equipment protection design rules. Shield topology should be optimal for certain configuration, i.e. to provide necessary protection level at minimal project cost.

The topology of shielding system must be developed in such way, that it would be possible to change its configuration in definite borders. Shielding zone boundary must not interrupt, for examples by reason of new open areas addition. All modifications are need to be considered by EMC experts, that guarantees EMC requirements implementation.

Grounding system must be implemented not only with purpose of safety, but considering its EMC efficiency. At present time general shield efficiency to zone shield efficiency distribution problem remains actual. It is need to know as technical problem aspects, so economical special purpose buildings aspects, which provides maximal project profitability.

It is need to pay attention to testing of just made object in shield efficiency. Usually the test equipment is not building company property, but this equipment needs EMC experienced operator. Otherwise test results may be nonsense, that leads to costly retesting and needless reconstructions. It is need to conduct test at building stage and finish test after all operations are completed.

If it is need to implement architectural EM shield at building stage, then it is to provide special training of building staff, which implements EM shields.

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LOCAL ELECTRO-OPTICAL NAVIGATION SYSTEM AGRICULTURAL MACHINERY.

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Keywords: navigation system, optoelectronic system, laser beam, atmospheric optical communication channel, meteorological visibility.

The most important element of precision farming is a navigation system. Currently in various areas of widespread satellite navigation system (SNS), which provide high accuracy coordinate measuring sufficient for different tasks, such as driving parallel, farmland mapping and monitoring techniques and crop yields [1-4].

However, SNS have quite significant drawbacks that hinder their rapid introduction in our country, it is:

high cost of equipment;

low immunity [5].

Therefore, the development of alternative navigation systems not only relevant, but also a must. The rapid development of optoelectronic and computer technology opens up the possibility.

Known navigation system, providing a solution similar to the problem of determining the coordinates in a bounded domain the earth's surface are widely used in aviation [6, 7] (landing system , the system range navigation) , road construction and agriculture . [8] All of these systems combine high demands on the accuracy of the system. At the moment the required precision (~ 1 cm) can be achieved only by using optoelectronic means. So the idea of the proposed system is to provide a discrete electromagnetic field in the infrared range (1.55 mkm .), which will provide all-weather navigation and around the clock farm machinery within a few kilometers.

Consider the device proposed system shown in Figure 1.

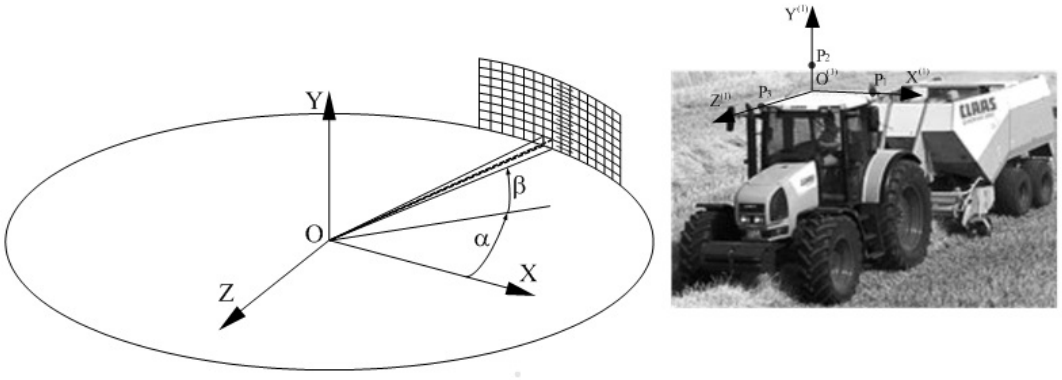

Figure 1 - Optoelectronic navigation system

At the beginning of the horizontal coordinate system is OXYZ laser beacon, providing scanning near-earth space narrow semiconductor laser beam. The laser beam is modulated depending on the rotation angle α of the axis OX in azimuth and height - β. Laser beam scanning can be a line-frame method which has been used successfully for decades in television (Figure 2).

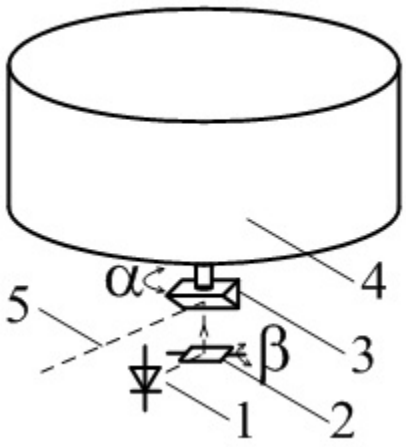

Figure 2 - The device scans the laser beam:

1 - Laser transmitter 2 - mirror sweep vertically 3 - mirror horizontal scanning 4 - motor, 5 - laser beam.

Laser beam scanning apparatus illustrated in Figure 2 provides the horizontal scanning 360 °, if necessary, to narrow the horizontal scanning mirror 3 must be in the form of an equilateral pyramid. The most promising scanning device in the near future will be apparently, quantoscopes [9], which is a solid state electronic device.

On agricultural machine has a group of spaced photodetectors P1, P2 , P3, which take the laser light and the received signals after demodulation signal formed three α1, α2, α3, the angular position of photodetectors in azimuth and elevation $\beta_1, \beta_2, \beta_3$ coordinate system OXYZ . Believe photodetectors that coordinates $P_1(B,0,0)$, $P_2(0,B,0)$, $P_3(0,0,B)$, in the coordinate system $O^{(1)}X^{(1)}Y^{(1)}Z^{(1)}$ are known . The problem consists in determining the linear and angular position of agricultural machines in the system OXYZ specified coordinates x, y, z position of the origin $O^{(1)}$ and angles ψ, γ, υ - determining the angular position of Systems $O^{(1)}X^{(1)}Y^{(1)}Z^{(1)}$ in the system OXYZ .

We write vectors OP_i and relations between these vectors

$$\overline{OP_1} = \overline{O^{(1)}O} + i^{(1)`}M$$
$$\overline{OP_2} = \overline{O^{(1)}O} + j^{(1)`}M$$
$$\overline{OP_3} = \overline{O^{(1)}O} + k^{(1)`}M$$

We project these equations on the coordinate axes OXYZ for this, multiply them in turn on the unit vectors i, j, k.

$$\begin{aligned} &x_1 - x_4 = ii^{(1)`}M.\ y_1 - y_4 = ji^{(1)`}M,\ z_1 - z_4 = ki^{(1)`}M, \\ &x_2 - x_4 = ij^{(1)`}M,\ y_2 - y_4 = jj^{(1)`}M,\ z_2 - z_4 = kj^{(1)`}M, \\ &x_3 - x_4 = ik^{(1)`}M,\ y_3 - y_4 = jk^{(1)`}M,\ z_3 - z_4 = kk^{(1)`}M. \end{aligned} \quad (1)$$

Express the coordinates of photodetectors through their angles measured

$$x_i = OP_i \cos\alpha_1 \cos\beta_1,$$
$$y_i = OP_i \sin\alpha_1 \cos\beta_1,$$

$$z_i = OP_i \sin\beta_1 .$$

Using the latter relations, we transform the expression (1)

$$OP_1 \cos\alpha_1 \cos\beta_1 = ii^{(1)}\grave{}M + x_9$$
$$OP_1 \sin\alpha_1 \cos\beta_1 = ji^{(1)}\grave{}M + y_0$$
$$OP_1 \sin\beta_1 = ki^{(1)}\grave{}M + z_9$$
$$OP_2 \cos\alpha_2 \cos\beta_2 = ij^{(1)}\grave{}M + x_9$$
$$OP_2 \sin\alpha_2 \cos\beta_2 = jj^{(1)}\grave{}M + y_0$$
$$OP_2 \sin\beta_2 = kj^{(1)}\grave{}M + z_9$$
$$OP_3 \cos\alpha_3 \cos\beta_3 = ik^{(1)}\grave{}M + x_9$$
$$OP_3 \sin\alpha_3 \cos\beta_3 = jk^{(1)}\grave{}M + y_0$$
$$OP_3 \sin\beta_3 = kk^{(1)}\grave{}M + z_9$$

Exclude from these relations parameters OP_1, OP_2 and OP_3

$$\left.\begin{aligned}
&(ii^{(1)}\grave{}M + x_9)\sin\alpha_1 = (ji^{(1)}\grave{}M + y_0)\cos\alpha \\
&(ji^{(1)}\grave{}M + y_0)\sin\beta_1 = (ki^{(1)}\grave{}M + z_9)\sin\alpha_1\cos\beta_1 \\
&(ij^{(1)}\grave{}M + x_9)\sin\alpha_2 = (jj^{(1)}\grave{}M + y_0)\cos\alpha_2 \\
&(jj^{(1)}\grave{}M + y_0)\sin\beta_2 = (kj^{(1)}\grave{}M + z_9)\sin\alpha_2\cos\beta_2 \\
&(ik^{(1)}\grave{}M + x_9)\sin\alpha_3 = (jk^{(1)}\grave{}M + y_0)\cos\alpha_3 \\
&(jk^{(1)}\grave{}M + y_0)\sin\beta_3 = (kk^{(1)}\grave{}M + z_9)\sin\alpha_3\cos\beta_3
\end{aligned}\right\} \qquad (2)$$

Relative angular position of the coordinate systems OXYZ and $O^{(1)}X^{(1)}Y^{(1)}Z^{(1)}$ is described by the matrix of the direction cosines of the following form

$$A = \begin{bmatrix} \cos\psi\cos\upsilon & \sin\gamma\sin\psi - \cos\gamma\cos\psi\sin\upsilon & \cos\gamma\sin\psi + \sin\gamma\sin\upsilon\cos\psi \\ \sin\upsilon & \cos\upsilon\cos\gamma & -\sin\gamma\cos\upsilon \\ -\sin\psi\cos\upsilon & \sin\gamma\cos\psi + \cos\gamma\sin\psi\sin\upsilon & \cos\psi\cos\gamma - \sin\gamma\sin\upsilon\sin\psi \end{bmatrix} = \begin{bmatrix} ii^{(1)} & ij^{(1)} & ik^{(1)} \\ ji^{(1)} & jj^{(1)} & jk^{(1)} \\ ki^{(1)} & kj^{(1)} & kk^{(1)} \end{bmatrix}$$

We substitute into (2) expressions for the coefficients of the matrix of the direction cosines

$$\left.\begin{aligned}
&(M\cos\psi\cos\upsilon + x_9)\sin\alpha_1 = (M\sin\upsilon + y_0)\cos\alpha_1 \\
&(M\sin\upsilon + y_0)\sin\beta_1 = (z_9 - M\sin\psi\cos\upsilon)\sin\alpha_1\cos\beta_1 \\
&(M\sin\gamma\sin\psi - M\cos\gamma\cos\psi\sin\upsilon + x_9)\sin\alpha_2 = (M\cos\upsilon\cos\gamma + y_0)\cos\alpha_2 \\
&(M\cos\upsilon\cos\gamma + y_0)\sin\beta_2 = (M\sin\gamma\cos\psi + M\cos\gamma\sin\psi\sin\upsilon + z_9)\sin\alpha_2\cos\beta_2 \\
&(M\cos\gamma\sin\psi + M\sin\gamma\sin\upsilon\cos\psi + x_9)\sin\alpha_3 = (y_0 - M\sin\gamma\cos\upsilon)\cos\alpha_3 \\
&(y_0 - M\sin\gamma\cos\upsilon)\sin\beta_3 = (M\cos\psi\cos\gamma - M\sin\gamma\sin\upsilon\sin\psi + z_9)\sin\alpha_3\cos\beta_3
\end{aligned}\right\} \qquad (3)$$

The resulting system of nonlinear equations in the unknowns $x_9, y_0, z_0, \gamma, \psi, \upsilon$, can be solved by one of the numerical methods, such as Newton, Adams, successive approximations. It is also possible the transformation of the system by eliminating the variables x_9, y_0, z_0 in a system of three linear equations in the unknowns γ, ψ, υ. After the decision, which, by the

numerical method, the remaining unknowns can be found by solving a system of three linear equations.

Since this method of measurement relates to navigation, it is extremely important question of the potential reliability and accuracy of the system in case of its realization.

The reliability of such position measuring system may be insufficient due to the influence of atmospheric conditions on the data connection that occurs between the beacon transmission signals α_1, α_2, α_3, β_1, β_2, β_3 and photosensitive receivers. Therefore, without evaluating the reliability of such information channel review of the proposed method of measuring is not correct.

With proper installation and configuration of atmospheric optical communication channel , determining factor in the reliability of this channel are the weather conditions in that location [10]. Influence of the atmosphere appears to weaken the beam meteorological factors : rain, snow , fog, sandstorm , and man-made aerosols. Also, additional factors reduce the radiation power in the receiving plane are turbulent formation in the atmosphere and their interaction with the laser beam , which leads to the so -called " jitter " and beam " spot " in the plane of reception.

Estimate of the probability of failure of optical communication channel to carry out the method presented in [10]. Terminology used in this paragraph corresponds to that used in the article.

The main parameter describing the interaction of optical radiation with the atmosphere , is the meteorological visibility (MDV) . Weather conditions differ not only for different geographical areas, but also from year to year . Statistical parameter of weather for a particular geographic location , determining the reliability of the communication channel is a time share for the year during which MDV is less than a predetermined value . Statistical processing meteorological observations allowed us to determine the empirical relationship of this parameter on the distance of the following form [10]

$$W(L) = a_i L^{b_i}, \qquad (4)$$

wherein W (L) - the probability of occurrence of the weather conditions in which less than the distance WDM optical communication channel L, m, a_i, b_i - constants for a particular geographical point.

Constant for a particular geographic point (various cities of Russia) are shown in Table 1, they are designed for the observation period of several years for some cities located in different geographical regions of Russia.

Since there are currently no complete theoretical studies that evaluate the reliability of the communication channel parameters, as well as the average effect of the receiver aperture and take into account the destruction of coherence by aerosols of the atmosphere, it is suggested that an empirical relationship that evaluates these factors [10]

$$I = \frac{2{,}5 \cdot 10^{-3} V}{2} \left(\frac{\Theta L}{D_r} \right)^{\frac{3}{4}} \qquad (5)$$

where I - the likely attenuation at a distance L, dB

L - the distance from the transmitter to the receiver, m,

Θ - The total angle of divergence of the radiation transmitter glad, rad,

D_r - aperture diameter of the optical system of the receiver, m

Expression (5) was obtained from direct measurements, as well as data from other manufacturers atmospheric optical communication lines, particularly Optical Access [9].

Using Bouguer's law, as well as the geometric attenuation factor, from the expression (5) we obtain an equation for determining the maximum path length for a given WDM

$$10\lg\left(\frac{P_t}{P_r}\frac{D_r^2}{\Theta^2 L^2}\right)+10\lg\left(e^{\frac{3{,}92L}{1{,}2V}}\right)-\frac{2{,}5\cdot 10^{-3}V}{2^N}\left(\frac{\Theta L}{D_r}\right)^{\frac{3}{4}}=0 \qquad (6)$$

where P_t - Pulse Power, W,

P_r - Receiver sensitivity at signal / noise ratio 10/1, W,

V - meteorological visibility, m,

N - the number of transmitting lasers.

Factor of 1.2 when V takes account of the wavelength infrared lasers (0.8-1.6 m). [10]

Using expressions (4) and (6), we obtain the relation for determining the reliability of the communication channel depending on the distance and weather conditions for a particular location

$$W(L)=a_i\left[\frac{1{,}42\cdot 10^{-3}L}{\lg\left(\frac{P_t}{P_r}\frac{D_r^2}{\Theta^2 L^2}\right)-\frac{2{,}5\cdot 10^{-3}V}{2^N}\left(\frac{\Theta L}{D_r}\right)^{\frac{3}{4}}}\right]^{b_i}. \qquad (7)$$

The expression (7) are used in the calculation of the probability of failure of optical communication channel for different geographical regions, such as Izhevsk, Yaroslavl, Kirov. At the same time, as the initial data used to calculate the following values constants ai, bi for a particular geographic point (Table 1), the angle of divergence of the radiation 10^{-5} rad. Diameter aperture of the optical system of the receiver 0.01 m, MDAs - 30 m , N = 1.

Table 1 - The value of the constants for a particular geographic point

city	a_i	b_i
Kirov	0,006	1,42
Izhevsk	0,013	1,21
Kostroma	0,008	1,26
Yaroslavl	0,009	1,32
Ivanovo	0,0065	1,53
Vladimir	0,011	1,47
Nizhnij Novgorod	0,013	1,28
Saransk	0,0115	1,39
Ryazan	0,006	1,46

The calculation result is shown in Figure 3. It illustrates the probability of failure of an optical communication channel depending on the distance chosen in different geographical locations.

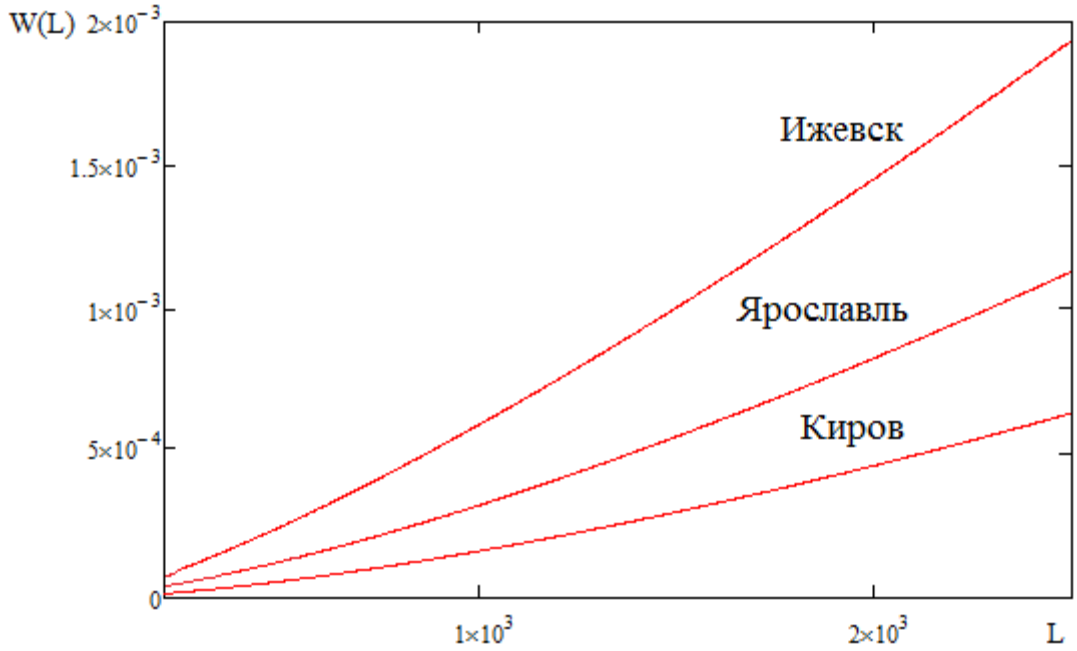

Figure 3 - The probability of failure of optical communication channel

Using such estimates allows a high degree of certainty to determine the reliability of the communication channel for a given distance or allowable distance for a given reliability of the communication channel.

Maximum probability of failure at a distance of 2 km to the city of Izhevsk (the worst area for the functioning of the system) is equal to 1,4 × 10^{-3}, and the probability of failure-free operation - 99.86%. Easy to calculate that the link will not be available within one year of just over 12 hours.

Let us consider the potential accuracy of the proposed system for this, we estimate the cross section of the laser beam at a working distance of 0.2-2 km. When beam divergence Θ and distance L section of the beam is determined by

$$\Delta = \Theta \cdot L = 10^{-5} \cdot 10^{3} = 10^{-2} m.$$

At a distance of 1 km. section of the laser beam will have a magnitude of 1 cm, which determines the order of measurement errors. For comparison positioning system GPS (GLONASS) in differential mode errors are tens of centimeters. That allows us to conclude that the proposed system can be quite competitive in solving local navigation.

Thus, the proposed system provides a complete solution to the problem of navigation, as determined not only by the location of the agricultural machine (coordinates x_9, y_0, z_0), but its angular position (corners γ, ψ, υ).

Calculating unknown provides real-time knowledge of the coordinate position of the machine, and enables automation of traffic control in accordance with the problem to be solved.

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THE CAPACITOR WITH INTEGRATED CHARGING CURRENT CONTROL UNIT

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This article provides the background for design of oxide capacitor with an integrated charging current control unit on the basis of a microcontroller mounted inside and / or on its surface. This increases the reliability of capacitor.

Keywords**:** oxide capacitor, microcontroller, current control unit.

One of the most unreliable blocks of electronic devices is a power supply, due to often failures of oxide (electrolytic) capacitors on the output of the rectifier both in high and low voltage circuits. Causes of defects can be either internal (aging, technological and structural defects) or external (climatic, mechanical and electrical), and also may be caused by the capacitor's operating mode (high inrush current).

Failure of rectifier filter capacitor is common to all types of secondary power sources designed with low frequency mains transformer, and with a transformerless input in pulse-type sources. Fig. 1 shows the current pulse when the power supply is first turned on. As can be seen, the amplitude of the current reaches 300A.

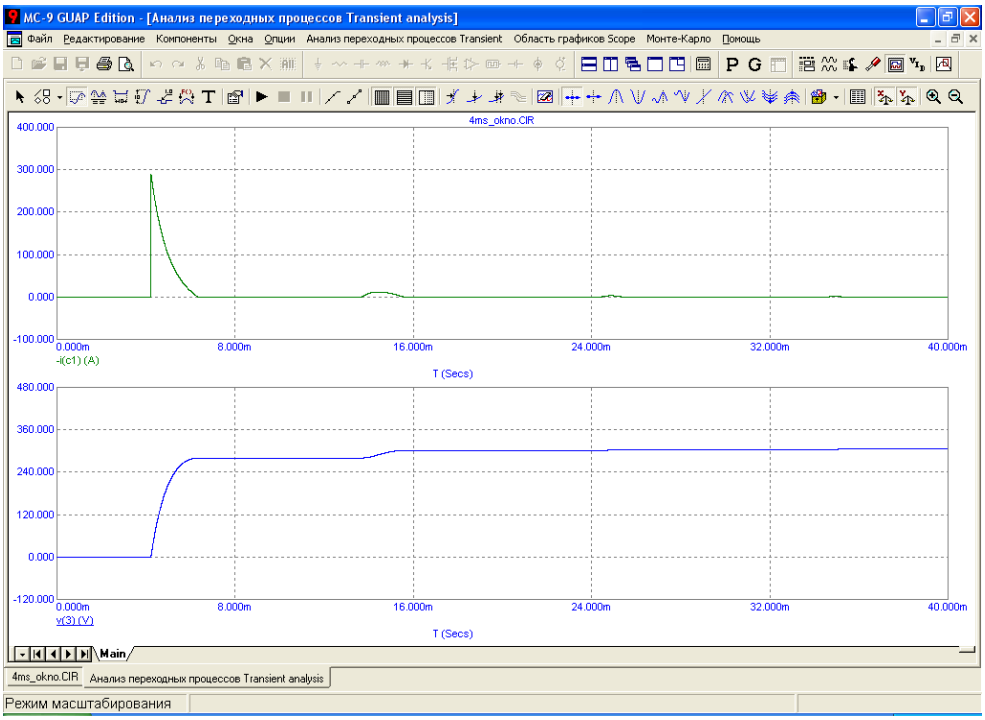

Fig.1

Given the importance of the issue, capacitor charging current limiters are used in electronic equipment to provide "soft mode switching" power supplies. However, their practical application has shown that though they provide the necessary "soft" launch, they are unsuitable in cases where reclosing is required due to prolonged relaxation state. This makes it impossible to use them in the circuits operating in the periodic pulse mode (train) (for example, a laser power supply circuits and industrial installations, etc.).

In addition, classical schemes of charge current limiters do not include changes in the internal parameters of the capacitor such as temperature, pressure and so on. It is known that the excessive operating temperature of the capacitor leads to its rapid degradation. This implies that the adaptive adjustment of the current during charging of the capacitor in the real time increases reliability and safety of the capacitor. It is also obvious that arrangement of a control system separately from the capacitor dramatically increases the complexity of the control parameters of the internal environment, and requires an additional capacitor lines with sensors located within the capacitor.

The authors obtained a patent for utility model adaptive control system microcontroller located inside the capacitor case or on its surface.

The idea of using a microcontroller in the control circuit charging current of the capacitor to create a universal device that does not depend on the parameters of the spread elements of power and purpose power source that will improve the reliability of the capacitor.

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CASE STUDY OR FOREIGN DIRECT INVESTMENT TO RUSSIA

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After overcoming the economic crisis in the 1990s, Russia has returned to the position of the world power and it holds the leading position among the countries that are the most attractive for the inflow as well as outflow of foreign direct investments; even though there is still significant amount of obstacles (legislation, corruption, etc.) that block the country to fully use the potential of the foreign direct investments, the accession to World Trade Organization, cooperation with Belorussia and Kazakhstan (Common Economic Space) or the Euro-Asian Economic Union as well as the privatization process represent steps how to maintain and strengthen the attractiveness of Russia as locality for foreign direct investments.

Key words Foreign Direct Investments, Multinational Companies, Russia

Within the scope of my dissertation work I primarily focus on three phenomenon, i.e. multinational companies (MNCs), foreign direct investments (FDI) and Russia. The multinational companies are usually connected with globalization [1] as a process that increases the dependency of markets and national economies, caused by high dynamics of the trade with goods, capital, Services and know-how and technology transfer [2]. Although the multinational companies are not the only subject connected with the globalization, we are witnesses of unprecedented concentration of power that exceeds the power of majority of national governments. As a result of this fact the multination companies become dominant subject connected with globalization. There are approximately 40 thousand of multinational companies in the world. As a consequence, we see the dominancy of standardized products and brands. Because of previously mentioned multinational companies are determined as negative

globalization aspect because they eliminate not only small and medium sized companies but also so-called classical international companies that respect and reflect local rarity and preferences [3].

The aim of this paper is to define the term foreign direct investments; moreover to inform about the scope of foreign direct investments in Russia.

Foreign direct investments – term definition

Term definition of foreign direct investments is quite diverse, however foreign direct investments are usually characterized as such an investment that represents ownership of a property in an economy other than that of foreigner direct investor. This ownership enables control and decision power over an enterprise on the basis of sufficient share on the entire property.

Some of the institutions as for example Organization for Economic Co-operation and Development (OECD) or Eurostat (European Statistic Office) include to their definitions of foreign direct investments also minimum amount of targeted registered capital – thus, foreign direct investment is such a capital structure of a foreign investment, whose purpose is to establish and maintain long-term relationship with foreign enterprise and a significant degree of influence on the management of the enterprise is performed in the given period of time. At the same time such an investment represents at least 10% of registered capital.

Definitions of other institutions usually do not include determined specification of minimum investment in registered capital.

Table No. 1 – Definition of Foreign Direct Investment according International Monetary Fund (IMF)

„…an investment that is made to acquire a lasting interest in an enterprise operating in an economy other than that of the investor, the investor's purpose being to have an effective voice in the management of the enterprise" [4].

Table No. 2 – Definition of Foreign Direct Investment according United Nations Conference on Trade and Development (UNCTAD)

„ Foreign direct investment (FDI) is defined as an investment involving a long-term relationship and reflecting a lasting interest and control by a resident entity in one economy in an enterprise resident in an economy other than that of the foreign direct investor. FDI implies that the investor exerts a significant degree of influence on the management of the enterprise resident in the other economy" [5].

Table No. 3 – Definition of Foreign Direct Investment according Organization for Co-operation and Development

„FDI reflects the objective of obtaining a lasting interest by a resident entity in one economy in an entity resident in an economy other than that of the investor. The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise" [6].

As it results from the above mentioned definitions Foreign Direct Investment are characterized by the following aspects:

- territorial aspect – foreign direct investments head for entrepreneurial activity realized in an economy other than that of an investor,
- ownership, respectively management aspect – investor owns such a stock share that enables him to control and manage the enterprise,
- time aspect, i.e. long-term investment – it differentiates foreign direct investments from portfolio investments that represent investment in short-term securities and shares.

Foreign direct investments can be classified according various criteria. Classification of foreign direct investments is used for example for statistical purpose or analysis. There are the most frequently used forms of foreign direct investments provided in Table No. 4.

Table No. 4 – Forms of Foreign Direct Investments

Criterion	Form of FDI	Comment
Degree of control	Associated enterprise	Share below 50%
	Subsidiary	Majority share
Investor's entry	„greenfield" investment	Construction of completely new company
	„brownfield" investment	Investment connected usually with revitalization of existing enterprise
	Merger and acquisition	Control of existing enterprise
Investor's motivation	Market	Access to new markets
	Production factors	Production optimization
	Specific assets	patent, license, brand

1. Development of Foreign Direct Investments

Foreign Direct Investments are not a phenomenon of today, the expansion of foreign direct investments is significant already in the 19th century, for example Great Britain provided definitely not small loans for the growth of other economies where it had its interest at that time. The First World War brought obvious decline, traditional European powers such as Germany, France or the Netherlands lost significant share on foreign demand and trade. World crisis in the 1930s and subsequent restriction of the trade as well as insolvency did not support increase in foreign direct investments at all. On the contrary after the Second World War foreigner direct investments (flowing mainly from the United States) represented the main engine of the by war destroyed economies.

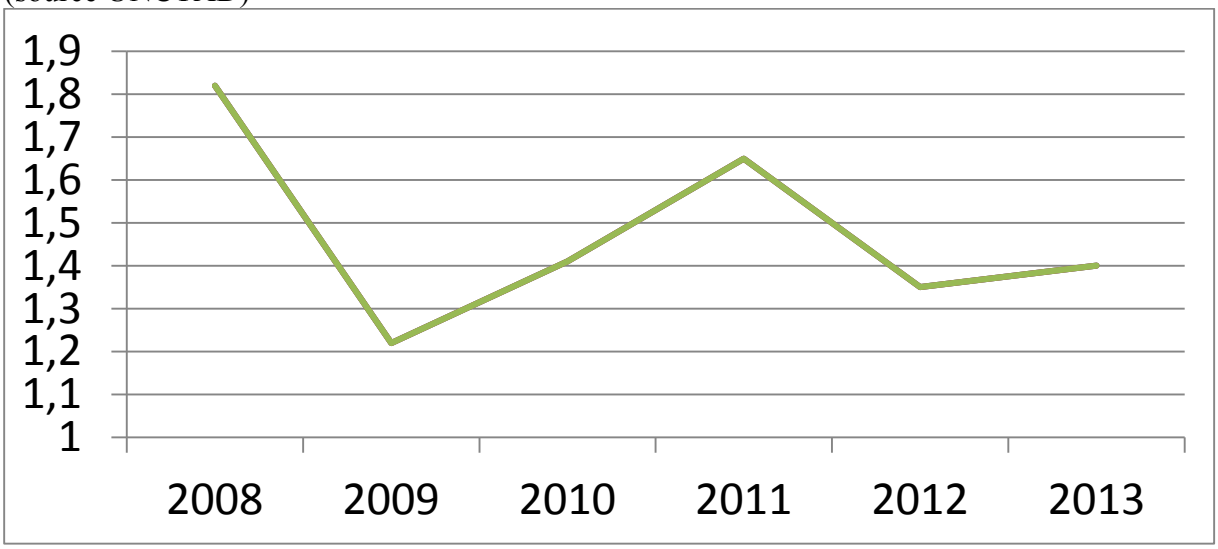
The situation changed in the 1960s, foreigner direct investments from the USA weakened and we saw a strong inflow of investments to the USA. During the 1980s the USA became net recipients of foreign direct investments and new players arose, especially Japan. Intensive support of foreign direct investment development is typical for 1990s. Such a boom of foreign direct investments was consequence of several factors, i.e. transfer of many countries to the model of free market economy, process of liberalization, growing globalization connected with expansion of multinational companies, overall economic growth and technological progress.

Positive development stopped between years 2000 and 2001 thanks to the slow-down of the economic growth, slump in financial markets (cases as Enron and others lead to mistrust in accounting of large multinational companies), last but not least it is impossible to forget the upcoming war against terrorism. All these lead to the increase of uncertainty and insecurity among investors. The development of foreign direct investments at global level [8] since 2008 with prediction for 2014 is described in the following table and chart.

Table No. 5 – GDP and Foreign Direct Investments 2008 – 2014 in % (source UNCTAD)

	2008	2009	2010	2011	2012	2013	2014
GDP(%)	1,4	-2,1	4,0	2,8	2,3	2,3	3,1
FDI (%)	-9,3	-33	15,8	17,3	-18,2	3,6	17,1
FDI ($)	1,82	1,22	1,41	1,65	1,35	1,4	1,6

Chart No. 1 – Development of Foreign Direct Investments in Billion USD 2008 – 2013 (source UNCTAD)



2. Multinational Companies

Just as there is no single definition of foreign direct investments, also multinational companies are defined in different ways. Usually we understand under the term multinational companies such an organization that includes enterprises or other entities registered in more than one country and interconnected in such a way that they ate able to coordinate their activities in different ways and modes [7]. OECD defines multinational companies in such a way, similar definition can be found by UNCTAD as well. Some institution defines minimum number of countries, in which the multinational company mush have its subsidiaries otherwise it is considered as multinational. There is also a term "transnational company" in place. Such a company must have its subsidiaries at least in 7 countries other than the seat of the parent company.

The total number of multinational companies is estimated to circa 60 thousand, number of their subsidiaries to 0.5 million. However, „only" 800 companies have a real influence at the global level. As I have already mentioned, multinational companies are considered as key players of globalization, because they

- initiate and implement technological innovations,
- develop workforce,
- contribute to the majority of international transactions,
- are able to plan, organize and control cross-border cooperation,
- fully use the advantage arising from the development of information and telecommunication technologies.

Multinational companies are not a new subject of the economic theories but their sharp expansion and concentration of power has started in the 1960s. At that time the multinational companies often disputed with national governments. Situation changed during the 1980s when the privatization processes in many countries started. This sharp increase in number and

influence of multinational companies went hand in hand with negative aspects and harmful social consequences especially in the field of unequal distribution of incomes and welfare.

3. Russia

The Russian Federation is the largest successor country of the former Soviet Union after its collapse in 1991. Thanks to its area exceeding 17 mil. km^2 Russian Federation is the largest country in the world. It is also the world's ninth most populous country with over 143 million inhabitants. After lengthy economic and social crisis in the 1990s, the Russian Federation returned again among world's ten economies. Its domination is based on enormous wealth of natural resources – especially mineral resources, oil, gas and wood. Oil export is one of the key pillars of current Russian economy; owing to it Russia has positive trade balance.

4. Inflow of foreign direct investments to Russia

Although the entry to the Russian market is connected with significant barriers, Russia belongs among the most attractive destinations for the foreign direct investments. Key elements of Russian market attractiveness are:

- increasing consumer market,
- increasing disposable income,
- increasing middle class,
- availability of all resources,
- available and experienced workforce.

While in 2012 the foreign direct investments reached approximately the same level as in 2011 considering the number of investment projects, regarding the volume there is circa 7% decrease [8]. Significant increase (60%) was registered in overall number of jobs created as an impact of foreign direct investments. The positive rise in number of jobs was caused by increase on average project size and expansion of existing projects.

Taking into account the sectors, the most important one remains manufacturing industry for the foreign direct investments, especially the automotive industry. The geographical origin is connected with the sector view – investors from the USA, Germany and France are at the top among investors. Number of investment projects from Germany doubled in comparison with year 2011 thanks to the automotive industry.

Picture No. 1 – Regions of Russian Federation

On the paper only the most important countries of origin of foreign direct investments to Russia as well as recipient of foreign direct investments from Russia are offshore heavens as Cyprus, British Virgin Islands or the Netherlands. Russian companies, because of tax reasons established their subsidiaries in these locations. For example the second biggest Russian steel producer, Evraz, is owned by a Cypriot company; similarly the fourth biggest steel producer (NLMK) is owned (85,5%) by Fletcher Group Holding from Cyprus. Moreover, this company belongs to other Russian investor.

From geographical point of view there are traditional differences among individual regions of Russian Federation. Favorite locations to which majority of investments flows are Moscow and St. Petersburg, gradually increase the importance of also other regions – for example Kaluga and Novgorod. Geographical disproportion is given by insufficient infrastructure.

Conclusions

According to Ernst and Young study [9] Russia is the sixth most attractive location for the foreign direct investments. However, administrative obstacles, corruption, further imperfection in legislation and significant differences inside the country prevent from taking the entire potential of foreign direct investments. Membership of Russia in World Trade Organization helped enormously the investment environment and credibility of the entire economy. Similar importance is seen in gradual co-operation among Russia, Kazakhstan and Belarus (Common Economic Space) or Euro-Asian Economic Union.

At the end it is necessary to mention that Russia is not only recipient of foreign direct investment but also important investor. Russian multinational companies begin to invest in Africa, in 2011 their investments in this region represented amount of 1 billion USD. Their motivation is to increase supplies of resources, expand to new segments of strategic commodities as well as to reach new markets. At the same time we cannot forget to underline the key role of state-owned-companies in the field of investment activities.

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OPTIMIZATION OF DEVELOPMENT OF THE BASIC EDUCATIONAL PROGRAMS OF PROFESSIONAL EDUCATION BASED ON IMPLEMENT OF INTELLECTUAL INFORMATION SYSTEM

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The article considers the peculiarities of modern educational programs development for training of graduates, describes the automation of the procedures of expert evaluation in the framework of the new system for the identification of the level of competence according to the Federal state educational standard.

Keywords: the main educational program, competence-based model, the automatic system of expert appraisal, expert systems.

The dynamism of changes of normative base that regulates the content of educational standards updates the processes of search of the optimal procedures of the Basic educational programs (BEP) development in various areas of training, that greatly affects the quality and effectiveness of the BEP. The educational process in universities in the modern dynamic environment depends on the information that is used to form the content, accuracy and reliability, as well as the requirements of the social order, as reflected in the BEP.

A significant number of processes in the life cycle of development and realization of the basic educational program is in character a qualitatively new, not always secured with information of appropriate to quality, particularly the formation of a competences matrix and passports competencies.

Getting accurate information from employers and correctness of its use substantially predetermine the optimality of the BEP formation on the basis of competence model. The main problem occurs during the formation of competences in blocks of subjects and in the regional component of the due to the lack of reliable data about the employers requirements to the graduates and the incompleteness of available information.

Solution of this problem lies in achieving the following goal: development of an automated system of expert assessment for the formation of the BEP bachelors. This goal can be achieved by solving the following objectives [1]:

- the system consideration and study of the “labour market” subject area, which participants are employers, jobseekers, in modern conditions of market are higher, as the interested part in the graduates preparation of the corresponding level, agreeable to the requirements of the social order;
- explore the possibility of applying the methods of expert estimates and opportunities for expert systems application for a marketing labour market and the requirements of employers for educational programs optimization in parts of the competence model;
- relying on the methods designed to increase intuition and experience of specialists – the method of expert estimation, to develop an information expert system.

Modern marketing research methods, and management decisions are based on the capabilities of information technology and software applications. This allows you to optimize all the processes and improve the quality of decisions based on its automation.

Nowdays there is a whole industry dedicated to the design of information systems (IS), including intellectual blocks for a wide range of analytical tasks methods. Such systems automate various stages of administrative activity. Based on the experience of development and explotation of this kind IS there was formed the basic methodology - expert systems (ES) as the systems based on knowledge.

"ES is a complex software accumulating expertise in specific subject areas and replicating this empirical experience for consultation of the less skilled users." [2]

Designed for the users who perform professional tasks, use the experience and knowledge of highly qualified specialists. The system is based on knowledge base, formed on the basis of expert estimations of experts.

There is also a separate class of information systems - automated expert estimation systems, which provide increase of efficiency of experience use of the highly qualified experts at making management decisions. The system uses the automation expert assessments of highly qualified experts, as expert opinions ensure the quality of their decisions.

Procedure of expert evaluation based on expert quantitative and qualitative assessments of processes, phenomena, is performed by experts on the basis of relevant indicators. Methods of expert estimations is the most simple methods and in a practical manner are the only possible with the complex pattern making any decisions.

There are two groups of expert assessments: the individual assessments are based on the use of the individual experts opinion, independent from each other; the collective assessment - the use of a collective expert opinion.

Analyzing the opinions of experts a variety of statistical methods are used, in particular, currently widely used methods of mathematical treatment of expert estimations. It is checking of the consistency of expert opinions and averaging expert opinions within a coherent group. This system that is based on the survey of employers by means of the Internet and the fixation of the user previous actions and content analysis of documents gives the most accurate and relevant information for universities on request. The essence of this method consists in conducting expert intuitive-logical analysis of the problem with quantitative assessment of judgments and formal processing of the results. Received in result of generalized view of experts processing is accepted as a solution to the problem.

Method of expert estimations is implemented in the framework of the use of such an expert system that is interesting to the participants of the "labour market". Employers search the employee corresponding to a certain set of requirements (competencies), the applicant is to find work, Universities is the demand for graduates, as well as a set of requirements of the social order. Analysis of the requests of employers and statistics in the labour market contributes to the University to identify necessary competencies and correction of training programs and competency-based models [1].

Algorithm of the method realization is shown below.

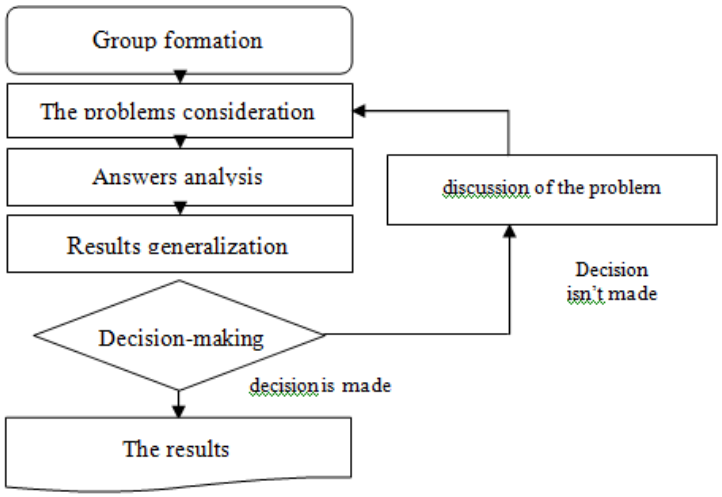

Fig.1. Algorithm implementation of the method

The method of expert estimation is directly connected to the search system, that allows not only automatically select the required user vacancy, but by analyzing the necessary information, to anticipate that may be really interesting to users.

The program realization of an expert estimations method. All the selected by employer competence are compared with the competencies specified by the competitors in the summary. If compared competence are the same, then the counter of the same vacancy is incremented. After comparing all the competences of the employer and employee, the program receives a number of matches. Before starting searching the employer chooses the accuracy which (in percentage) the program will look for the employee with. Number of competencies specified by the employer, are taken for 100%. The typical mathematical formula is calculated, what percentage of them hold the number of matched competencies, and if this percentage is more or equal to the percentage of accuracy, identity of the applicant gets into an array that contains the IDs of all suitable applicants, and then from the database displays a summary of all the users whose IDs are contained in the newly created array. This search is the first step in the expert estimation [1].

For the next stage we need a search function, which takes into account information about applicants what spheres of activity and what professions are interested in the most. The program also takes into account the plans of employers. There is a special function, using that the employer may specify employee of which position he plans to hire in a specified period of time. Thus, navigating to the search page, the employer immediately sees what employees could also be interested, even before the search.

The third stage of realization of an expert evaluation method. Having all the information specified by before employers and candidates that, the program starts to record the information specified by Universities, specifically the amount produced in a certain period of time specialists in other areas to the labour market. Thus, for example, the employer may be offered to young specialists in advance, even before he left the job. But this step does not narrow the initial terms of search - everything depends on the current desires of the employer and the results of the search will not be limited with just young specialists, which, as believed the program would be more interesting.

All these stages and functions similarly implemented for the job seekers and Universities. For the last expert assessment method gets the status of a supply and demand of specialists in the labor market. It gives a possibility to Universities, comparing information on the ratio of demand and supply of graduates and a required or offered by specialists, to determine the range of options, for example, as described above, reduce the number of hours of training Delphi or improve the basic educational program of forming the competence model.

Summarizing the above, we can give a brief description of the main program functions. It receives information, compares the information with another, coincidence counts and based on quantitative results provide the information that may interest the user, helping them in making decisions about the choice of necessary competences. In addition, the system stores information about user preferences and in time significantly speeds up the search for necessary information.

A group of students and lecturers of «Applied Informatics in Economics» of VRSUS has studied the experience of automation of the expert evaluation procedures in the framework of the new system for the identification of the competence level in compliance with the Federal state educational standard.

The system of criteria estimations was developed, which are the basis for the procedure, was determined the procedure itself, was chosen development environment and developed application of expert evaluation and search information from employers.

In the studies result there were obtained the following results: established operative interaction with potential employers through the information system, identifies the wishes of

the social order within the competence model, which allows to adjust the main educational program and improve the process of preparing graduates for the purpose of improving their competitiveness in the areas of «Applied Informatics», «Business Informatics», «Information security».

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IMPROVEMENT OF AUTOMOBILE WARRANTY SERVICE SYSTEM QUALITY BY MULTIDIMENSIONAL DATA ANALYSIS

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Abstract. Article is devoted to the opportunity analysis of motor vehicles warranty service system perfection due to planning and activity arrangement optimization of car centers. A basis for acceptance of the scientifically-proved decisions is the statistical data analysis of requests monitoring that allows organizing duly replacement of parts with expired service life, and also promotes client servicing quality improvement and reliability of motor vehicles by prevention of its refusals.

Keywords**:** reliability of motor vehicles, forecasting of refusals, the analysis of claims, information system

In conditions of economy globalization, avalanche growth of information volume and fast development of engineering and technology there is an opportunity search problem of new products fast introduction to the markets which stands before developers of complex and high technology motor vehicle products that are competitive in this segment and satisfying consumer’s expectations. Automobilization growth and an amplifying competitive struggle in the automobile market compel manufacturers of motor vehicles to improve production quality,

and also to search for new ways of client attraction. Confidence of car buyer plays an important role in opportunity of its problemless operation. It is especially actual for the guarantee period, as manufacturers pay special attention to it because any deviations from warranty policy can negatively affect reputation of a producer and lower trust to a brand among buyers and owners. Duly, fast and qualitative service is most demanded for owners of cargo motor vehicles, as at commercial operation of the car each excess idle hour of pending service is measured by the missed benefit.

As a rule, manufacturers, with the purpose of potential car buyer attraction, increase duration of the guarantee service period that is provided with opportunities of modern achievements in the field of designing and manufacturing of products, a substantiation of their reliability and quality increase ways. It is possible to provide quality of warranty service due to improvement of process quality and due to the prevention of the sudden refusals arising during the guarantee period. These two basic directions are connected with processing and information analysis, and also algorithm development, techniques and activities on fast reaction to changes of external and internal system parameters.

Quality of processes in the service center is defined by such factors as quality of scheduling, an equipment loading degree during a shift, trained personnel availability, spare parts and consumables availability necessary for maintenance service and repair. Last from the specified factors influencing quality of processes, is closely connected with the decision of a sudden refusals prevention problem. Motor vehicles reliability becomes one of primary factors of machinery competitiveness guaranteeing; therefore the problem of non-failure operation guaranteeing is solved at all stages of life cycle - from designing to recycling.

Operating a vehicle, it is necessary to remember, that any, even the most perfect motor vehicle, cannot carry out its functions for a long time without qualitative and duly maintenance service and observance of operation conditions. Duly parts replacement which have expired service life, allows not only to increase safety of the vehicle operation, but also to avoid failure of parts mating to them.

The most effective method of vehicle operational reliability increase is the prevention of breakdowns based on a technical condition forecasting at a certain operating time, and also planning of service time according to results of the analysis. Forecasting of the possible breakdown moment, i.e. probable defining that controllable parameter goes out acceptance limits in a definite time, allows to plan deliveries of spare parts under the nomenclature and quantity for duly replacement of unreliable elements in view of operation conditions, climatic conditions in specific region, season, type, model and a vehicle configuration [1].

Studying character effects can be based on the information on the breakdowns arising while in service, fixed in the form of claims of the consumer, after their careful processing and the analysis. The account of the information, its formalization and classification on malfunctions and the breakdowns, realized in the form of defects codifier, and also its analysis in view of various factors, allow to reveal the reasons of early breakdowns emergence and to take measures on their prevention. The system of gathering, formalization and the analysis of damage statements is necessary for this purpose which will allow the service centers experts to enter, and to employees of the producer company to look through and analyze claims.

For planning efficiency increase of structure and spare parts delivery time it is necessary to consider, that various car units, components and systems have a different resource and possess a different degree of reliability which depends on a set of the factors having stochastic character.

Breakdown information analysis of automobiles shows, that each model in the certain operation conditions at the fixed operating time has some number of parts, which breaks more often than others, named "limiting" reliability, or "critical" on reliability. Thus, in Kramarenko G.V. [2], opinion, on 15-18 thousand parts which the vehicle consists of, 3-4 thousand have

service life less, than the service life of vehicle itself, but only 400 parts are critical on reliability.

Breakdown of car unit, component or system arises during the moment of time $T_{break.}$, which with the certain probability can be predicted. According to technical products operating experience, change of breakdown rate $\lambda(t)$ of majority of objects is described by U-shape curve and is divided into three operational stages [3]:during running-in period the raised breakdown rate is observed which is connected with detail running-in and is caused, as a rule, by industrial defects (fig.1). During regular operation breakdowns have casual character and appear suddenly, first of all, because of non-observance of operation conditions, changes of loading, influence of adverse external factors, etc. (fig.2). The third period is characterized by increase of breakdown rate that is caused by ageing and other reasons connected with long operation.

It is impossible to deal with breakdowns during running-in period, but it is possible to reveal the parts on the basis of the references statistics analysis in a car center and the drawn up damage statements which are mostly subjected to early breakdowns.

During regular operation breakdowns appreciably depend on operation conditions, have stochastic character and that is why the forecast for spare parts demand is carried out on the basis of the dependences established by the DCC references analysis.

As the warranty period is the most important for maintenance of client's loyalty, first of all, a question on maintenance of qualitative service is solved during this period. Appointing the warranty period, the producer company includes not only running-in period, but also a part of regular operation period. However, as a curve breakdown rate nature testifies, dependences of breakdown quantity on an operating time on these sites are described by two essentially different laws. Therefore spare parts supply process should include two functionally various mechanisms.

So, at the service maintenance in the foreign markets the regular service mechanism at running-in period Spare Parts Warranty Packages (SPWP) is sent in a region of operation together with a party selling cars, which qualitative and quantitative structure is made with account of information on refusals during the previous period. Therefore SPWP qualitative and quantitative structure design procedure is necessary for a running-in period. Possible references planning method is necessary for a regular operation period owing to breakdown of this or that part in view of the statistical information analysis data under references to DSC during previous period. Such planning method serves a basis for a delivery date structure and calculation formation in control center of a dealer service network (DSN). Consignment structure in both cases is formed in view of the information on breakdowns during the warranty operation period [4].

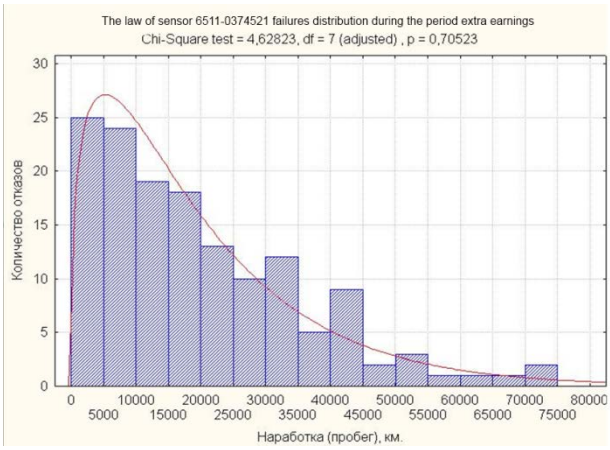

Fig. 1. Breakdown distribution of the gauge 6511-0374521 during running-in period

Fig. 2. Breakdown distribution of the gauge 6511-0374521 during regular operation

(latent defects of the manufacturer) *(external influences)*

The great number of parameters describing operation and car servicing conditions, and model range which is constantly updated causes a search of the means providing efficiency and accuracy of analysis carrying out. Guarantee complete set drawing up quality depends not only on services quality and cost, but also on regular operation of motor vehicles at running-in period. Therefore the optimum tool allowing reacting quickly to changes of external and internal system parameters are systems of Decision Making Support Systems (DMSS) which are based on the technologies using operative databases, storehouses of data, systems of operative analytical information processing and intellectual data analysis. DMSS is a complex of the interconnected models with corresponding information research support, expert and intellectual systems including experience of management problems decision and providing participation of experts during working out of rational decisions.

As decision-making is based on real data on management object, an aggregated information are applied for analysis and strategic decision making for storage of which Data Warehouse (DW) is created. The purpose of DW construction is integration, actualization and the coordination of operative data from diverse sources for formation of a uniform consistent view on an object of control as a whole. Data Warehouse contains information collected from several operative databases of OLTP-systems (OLTP (On-Line Transaction Processing) - operative processing of transactions in real time).

DMSS possesses means of granting of modular data to the user for various selections from an initial set in a convenient for perception and analysis way. Modular functions form a multidimensional data set (a hypercube or a metacube), where users can formulate complex inquiries, generate reports, receive data subsets. Such technology of complex multidimensional OLAP (On-Line Analytical Processing) data analysis is analytical processing in real time which is a key component of the Data Warehouse arrangement.

The general scheme OLAP system can be presented as follows [5].

The algorithm of work consists of following stages (fig.3):

1. Data acquisition in the form of the flat chart or result of SQL inquiry performance.
2. Data caching and its transformation to a multidimensional cube.
3. Display of the constructed cube by means of cross chart or diagrams, etc. Generally, arbitrary quantity of mappings can be connected to one cube.

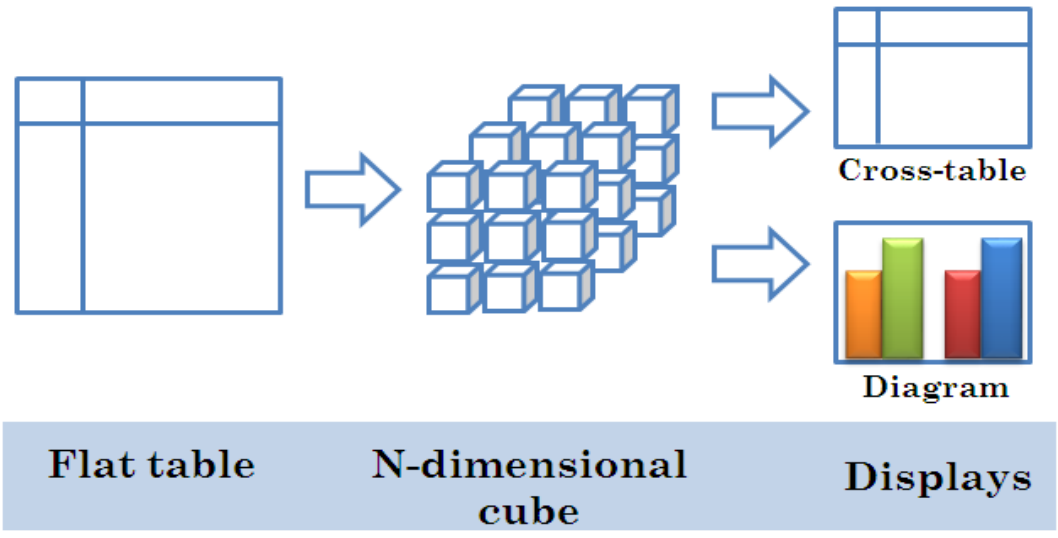

Fig. 3. General OLAP system scheme

Advantage of the given technology is that demands of so-called FASMI (Fast Analysis of Shared Multidimensional Information) test are made to appendices for the multidimensional analysis, including:

- Fast - the fast response of system (no more than 5 seconds),
- Analysis - the full-function analysis in a possible convenient way,
- Shared - the multiuser access, protection of the information, etc.,
- Multidimensional - multidimensional conceptual data presentation in the form of cubes with hierarchical measurements,
- Information - data accessing in required volume, where it is necessary.

Realization method includes various patented ideas: architecture versions "client-server", time series analysis, objective orientation, data storage optimization, parallel processes, etc. Application areas differ as well. So, in article [6] experience of an OLAP-cube application for the analysis of the product defects reasons in quality system of sewing manufacture is described, in article [7] the multidimensional analysis is applied for defect clustering at construction of bridges, in article [8] the expert system creation opportunity is described, based on knowledge and using the multidimensional data analysis for strategy construction at the logistical processes arrangement. Article [9] is devoted to the development of the computerized control system by maintenance service intended for the decision analysis, allowing revealing the reasons of failures in a system, in account of various criteria, such as time and frequency of idle times, availability of spare parts and others. The described technologies are realized in the form of DMSS for quality management [10, 11], and also for industrial systems and processes management at all stages of production life cycle [12].

While revealing reserves of automotive enterprise service centers processes efficiency increase it is necessary to consider, that various car units, components and systems have a different resource in different conditions and possess a different degree of reliability which, in turn, depends on set of factors having a stochastic character. In particular it is typical at expansion of commodity markets and development of DSN abroad.

Data about the reasons to apply to DSN with detailed elaboration of all parameters are fixed in a database and serve as the initial information for the subsequent analysis. Thus for formation of each selection one of factors is considered, but values of the others remain fixed. Law parameters of refusal distribution for each unit are defined on the generated data file by means of Statistica program [13]. Thus, according to the histogram of empirical data the schedule of distribution law is deduced and its conformity to selective data is defined at the set significance value. Results of the analysis serve for development and updating of the instructions intended both for the service centers, and for automobile owners which observance allows to provide trouble-free operation of the car.

As the number of refusals at developed DSN represents great data volume depending on significant number of factors, the above described OLAP technology was applied to data aggregation, allowing spending refusals analysis at the chosen combination of measurements. So, the three-dimensional OLAP-cube with simple measurements is displayed on fig. 4.

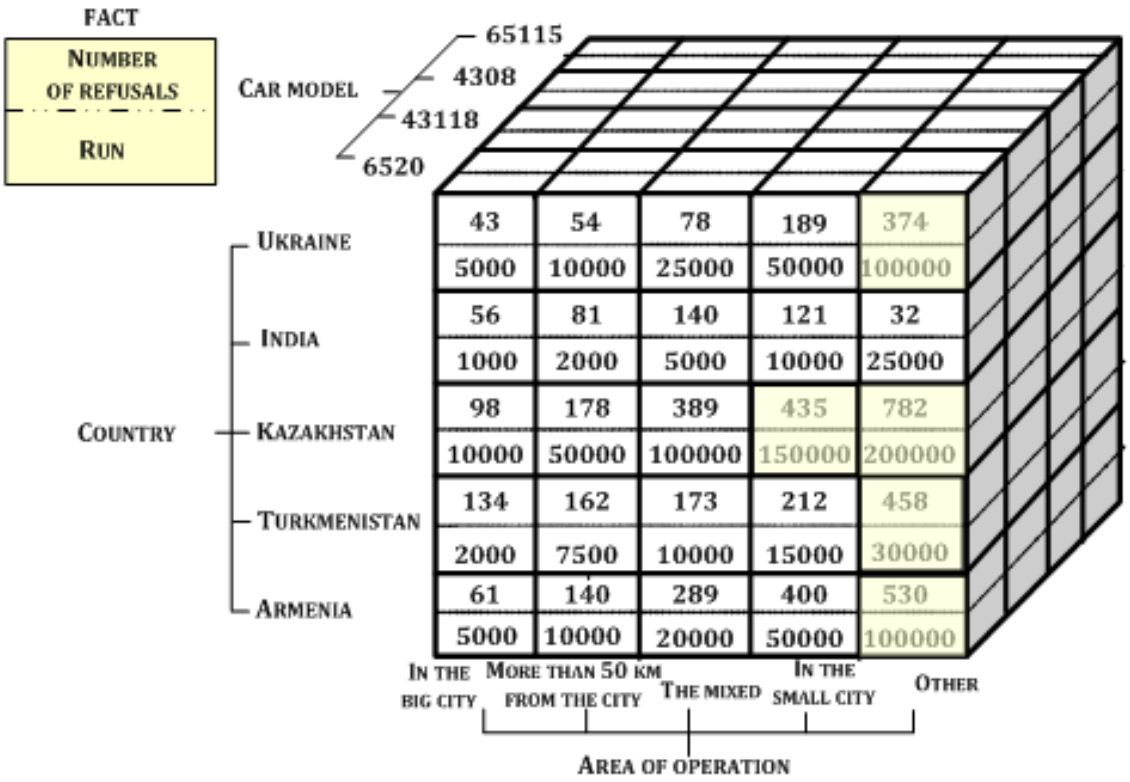

Fig. 4. Three-dimensional OLAP-cube with simple measurements

At breakdowns forecasting and car service planning the account of such factor, as climatic conditions as it renders essential influence on a parameter of reliability is necessary. Research of climatic conditions factor influence was done on the basis of statistical data sample on the breakdowns, accumulated by CJSC Foreign Trade Company of KAMAZ. At drawing up a breakdown distribution country by country the parameter of breakdown rate (i.e. breakdown quantity of one car) was considered, as the probability of their occurrence increases at growth of a motor vehicle fleet size.

Fig. 5 presents the diagram and function of breakdown distribution country by country. Thus factor of correlation $R^2 = 0,63$, that does not satisfy demanded accuracy for the purposes of forecasting and planning. To exclude influence of the climatic factor on the forecast accuracy, three groups of the countries has been allocated with similar climatic conditions on the basis of climate classification by Keppen V.P. [14].

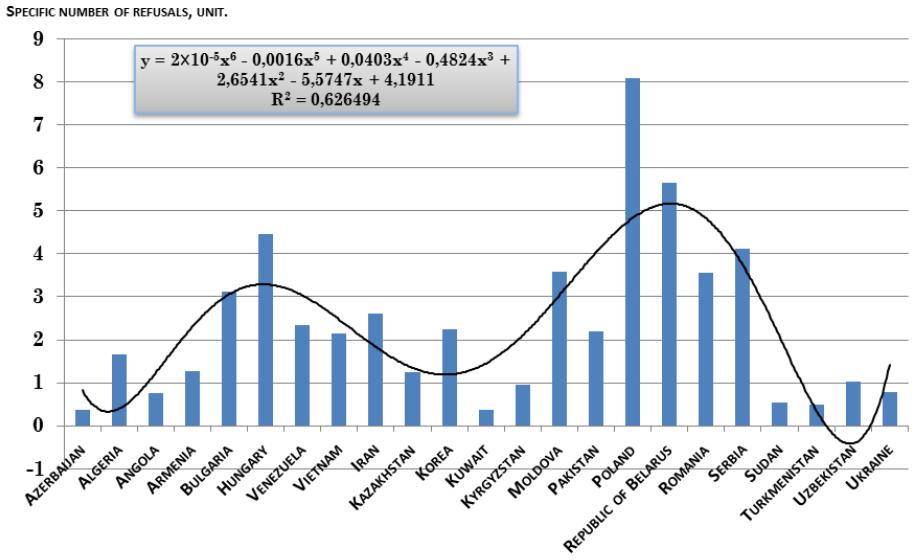

Fig.5. Breakdown rate distribution country by country

Schedules of breakdown rate distribution and functions of breakdown distribution were made separately for each country group (Fig.6-8). According to the given data, the coefficient of distribution law correlation for each of climatic country group is much more, than by their generalized consideration.

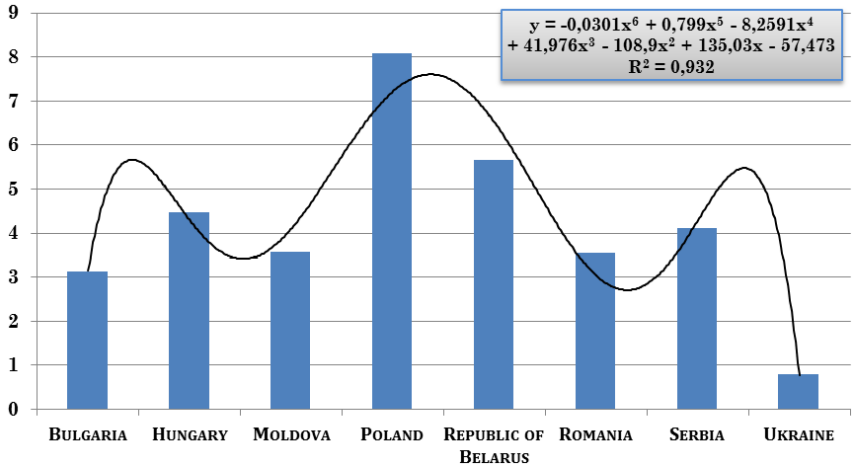

Fig.6. Breakdown rate distribution country by country of group 1

Results of performed researches testifies to necessity of taking into account the climatic conditions factor at breakdowns forecasting and car service planning.

As DSN provision abroad with necessary spare parts during the warranty period is one of prominent aspects of producer company warranty observance, the essential attention is paid to formation method development of their deliveries. Methods are formed on the basis of the breakdown statistics analysis during the warranty period. However, in our opinion, the insufficient attention is given to region climatic features.

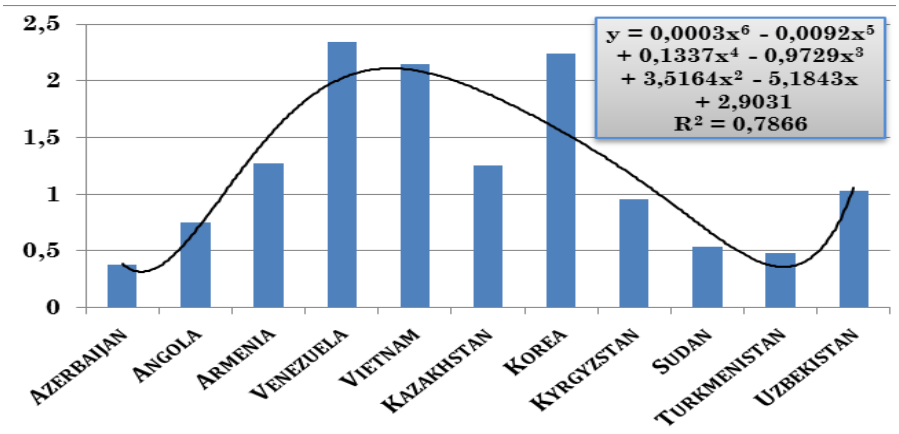

Fig.7. Breakdown rate distribution country by country of group 2

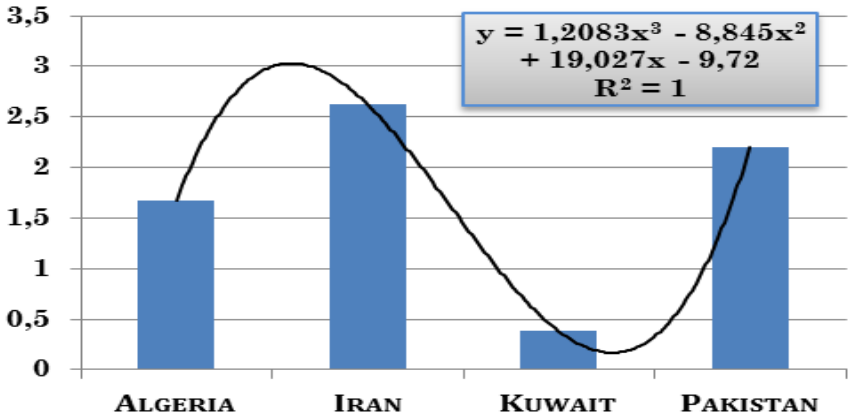

Fig.8. Breakdown rate distribution country by country of group 3

SPWP qualitative and quantitative structure conformity analysis for Cuba was made to confirm this thesis which has a climate of savannas and belongs to the second climatic group allocated according to climate classification of Keppen V.P. [14].

Available information on breakdowns has been grouped in units. The grouping of the spare parts which are a part SPWP has been done in the same way which was delivered in Cuba (table1). Received data were compared, that has allowed revealing deviations of SPWP structure from the number of breakdowns.

Such discrepancies lead to warehouses overstocking and service centers assets freezing because of a significant share of non-demanded spare parts and, at the same time, conduct to decrease in quality of service owing to increase in a waiting time due to absence of the necessary spare part. At commercial operation of automobile the increase of repair time leads to loss of confident of the client to a brand.

For conformity of SPWP structure its optimization has been made to the number of breakdowns. Results of redistribution are shown on fig.9 where the structure of the warranty packages is compared made by an available method and in view of Cuban climatic conditions.

Apparently from the diagram, optimized SPWP corresponds more precisely to breakdown distribution on the car units in the given climatic group.

Table 1. Comparison of SPWP structure to the information on breakdowns

Detail name	Breakdowns (%)	SPWP before optimization (%)	SPWP after optimization (%)
Ventilation, heating	0,95	0,16	0,95

Engine	5,69	38,34	6
Wheels and tires	3,89	3,1	3,1
Gearbox	2,94	0,16	2,94
Rear axle	2,93	4,73	4
Intermediate axle	4,81	4,4	4,9
Windshield	0,42	0,33	0,33
Front axle	2,56	3,1	3,1
Suspension	2,12	4,24	2
Gauges	8,7	2,77	8,7
Exhaust system	0,95	2,94	2
Cooling system	7,06	2,61	7,06
Fuel system	5,86	14,68	6
Break system	8,89	5,38	6,85
Clutch	8,2	0,98	8,2
Steering	4,38	0,65	4,38
Turnover car dumper	9,88	0	9,88
Electric equipment	19,61	11,26	19,61
TOTAL	100	100	100

Therefore it is possible to assert, that the application of SPWP drawing up method with a view of climatic conditions influence will allow harmonizing its structure to breakdown distribution on the car units.

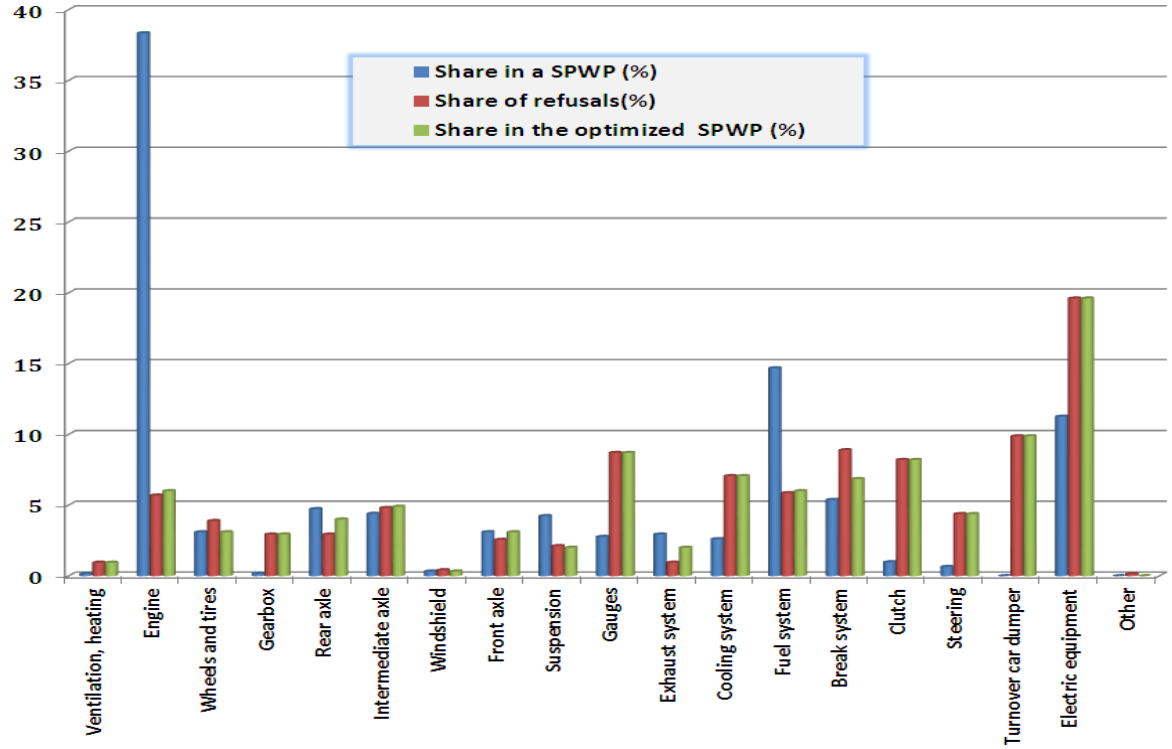

Fig.9. SPWP structure comparison to the information on breakdowns

Annual economic benefit for DSC due to reduction of unclaimed assets enclosed in spare parts warranty packages makes 37400 rubles. Economic benefit for the automobile owner, expressed by decrease in the size of the missed benefit due to repair idle time reduction makes 6992 rubles.

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EJDB – EMBEDDED JSON DATABASE ENGINE.

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Abstract Recently NoSQL databases are widely spreading in IT industry. Some of them are document-oriented systems which use JSON (JavaScript Object Notation) for data representation. In this paper we propose a novel embedded data storage system EJDB (http://ejdb.org) for JSON data which can be successfully used in software systems as shared executable library.

Keywords nosql; json; document store; embedded database; ejdb.

Today using JSON for data representation is becoming more and more ubiquitous after such schema-free document-oriented database management systems as mongodb and couchdb appeared on the market. They are very convenient for realization of server side applications, however are too heavy to embed databases inside light applications such as for desktop and mobile because of possible software security breaches, difficulties in maintenance and lesser speed.

As a solution to the mentioned problems we propose an embeddable JSON database, which can be used as a fast way to persistently store JSON data without any network overhead by simply linking with shared executable library. An approach to make this library on the base of existing mongodb system has faced essential restrictions, the main arising from the fact that Mongodb is distributed under copyleft AGPL (GNU Affero General Public Licence) [2], which doesn't permit to link any proprietary code with mongodb code, since, in this case, it has to be published under AGPL.

EJDB ARCHITECTURE

The basis of EJDB is general mongodb philosophy and its query language. A realization of EJDB is technically based on tokyocabinet key-value storage engine [4] which distributed under LGPL (Lesser GNU Public License) [3]. Storage system of EJDB is built on the low-level structures of data which provided by tokyocabinet library such as:

- B+ tree (tcbdb);
- Key-value hash based storage (tchdb);
- Table database (tctdb).

Inside EJDB JSON-documents are represented as BSON (Binary JSON) objects [5]. This format is quite compact and effective for storage and processing data. BSON objects can be compared to objects of binary interchange formats, i.e., Protocol Buffers [6]. BSON is schema free and more flexible than Protocol Buffers however it has a little space overhead comparing to Protocol Buffers.

EJDB stores a set of collections, where each collection contains a set of logically related JSON documents.

Logically every EJDB collection is a tokyocabinet table database (tctdb) which is schema-free table storage with data stored in rows split into set of user defined columns.

Every table row is split in three parts: 24-bit unique identifier, BSON encoded document body, and an additional document related metadata.

If documents do not contain indexed fields in query execution process entire documents collections will be scanned and BSON documents whose fields matched with

query will be selected.

Selecting document by primary key is reduced to fetching data record from disk backed hash table. This operation can be performed quite fast.

A. Indexes for JSON data

In order to speed up query execution document fields may be indexed. In our implementation every defined indexed field is backed by B+ tree database. Field values are stored in B+ tree and point to the primary keys (UUID) of BSON documents they refer. Four types of field indexes are supported: string index for matching string values; string index for case insensitive string matching; index for numeric types; inverted index for matching values in JSON arrays or in string values treated as set of space delimited tokens.

B. Queries

EJDB queries define a set of CRUD operations, on documents stored in collectons, i.e., create, read, update, delete. CRUD rules are represented as a set of BSON documents, which structure is similar to mongodb queries.

CRUD read operations define a set of field restrictions applied to a document collection. Since structures of JSON documents can be hierarchical fields fieldpath is used for the

identification of document. For example, a query condition to select books with particular publisher can be as follows: {“publisher.name” : “some publisher”}

C. Concurrency and transactions

In order to ensure data integrity in multi-threaded environment a read-write locking pattern is used to demarcate access to shared memory segments and data files.

On one hand, read-write locks are less efficient than MVCC (MultiVersion Concurrency Control) [7] technique especially with high ratio of writes. On the other side, read-write locks are easy to use. Moreover, rw-lock approach is quite fast when we have small ratio of writes and stored data is more compact in comparison with MVCC systems. However we plan to add experimental support of MVCC in order to provide true ACID transactions support. Currently EJDB provides atomic and durable non parallel collection level transactions, i.e. only one transaction is active in a single point of time.

E. Compression and encrypting.

All data in EJDB may be compressed using two algorithms: DEFLATE and LZ4.

Encryption is implemented using AES-128 encryption algorithms in the CBC (cipher-block chaining) mode with SHA-256 hash-function.

Encryption is realized as follows:

User enters her or his password to the database, after which {password@salt} combination is used for key generation, where salt is a random 16bit sequence generated at database creation. This sequence is then N times hashed (supposedly 1024). The result is the encryption key for all data stored in the database. These procedures protect the database from so called rainbow tables being used to break the encryption.

Each data block is written with an iniliazation vector being generated by taking hash value of the encryption key. Then all incoming data is split into blocks 16 bit each and data is encrypted with block cypher into the CBC (cipher-block chaining) regime.

Decryption is realized the same way with reversed order of operations.

CONCLUSION

The goal of EJDB project is creation of an open source embedded JSON-storage library for wide variety of platforms and programming languages which can be easily distributed and integrated with applications including proprietary applications. The niche of data management libraries was filled by EJDB at this moment which was currently empty but quite necessary. In future we plan to extend variety of available platforms for EJDB, in particular, to port it to Android and implement novel robust transaction mechanisms based on MVCC paradigm.

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DEVELOPMENT AXIOMS AND QUERY FOR ONTOLOGY OIL PRODUCTION

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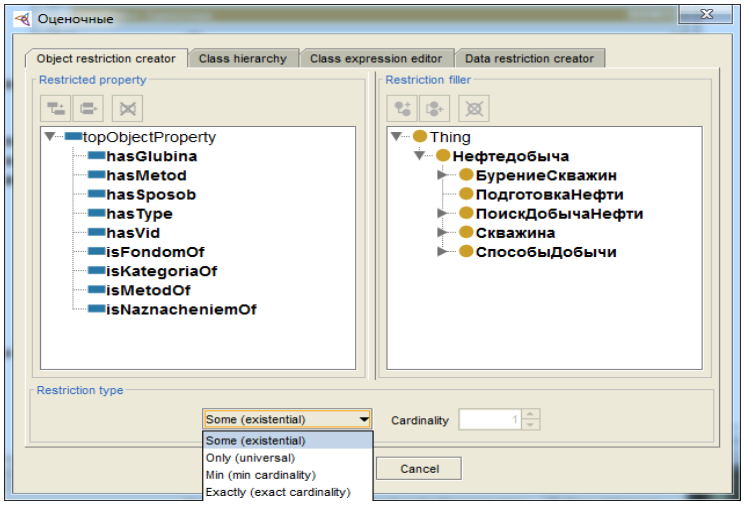
The paper presents the technology of ontological organization of data on oil production and application of results to solve the problem of effective search of scientific information in the indicated direction. The process of ontology development in the area of oil production, and provides methods for setting the basic axioms and types of job restrictions.

Keywords: ontology, oil production, axioms, query

Ontology defines a common vocabulary for researchers who need to share information in the subject area. It includes machine - interpretable formulation of basic concepts in the domain and the relationships between them [1].

Developing an ontology begins with domain analysis. Requirement for ontology development is moving towards a universal ontology, representing two-tier architecture. Ontologies enable structuring large amounts of data allow us to construct a system of concepts of domains and the relationships between them. Subject area you can imagine how many real concepts of interest to users. In ontology concept represented by an object that has properties and consisting of copies.

In the process of creating ontologies basic idea is that with a description of some concepts can give definitions, which eventually will ask our concepts. For this purpose, the axioms that define the monosyllabic affirmative statements which allow to describe a particular object. The more axioms we use to describe the concept, the "full" this concept is determined that eventually produces «implicit " knowledge of the subject under consideration. Axioms are defined by the rules of discretionary first-order logic. Picture 1 represented on the panel of the restrictions or axioms.

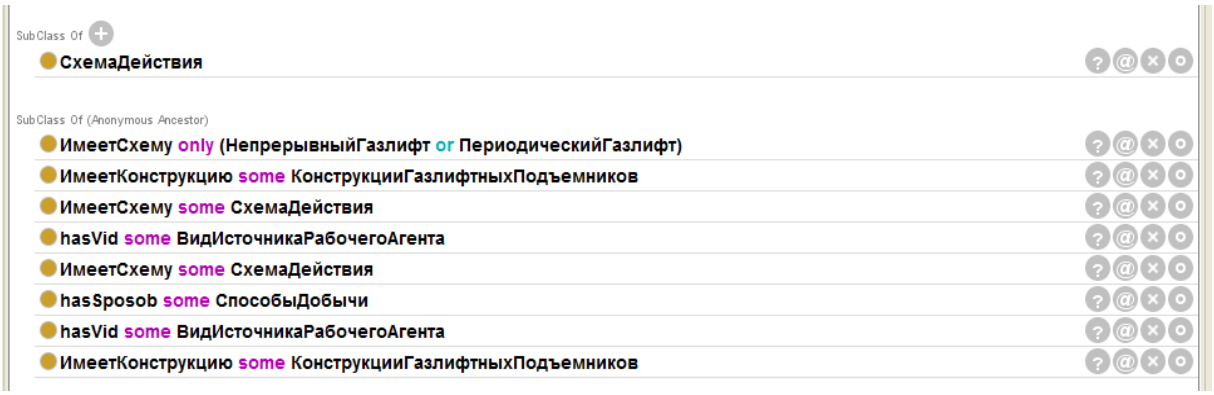


Picture 1 – Example of restrictions

There are five types of job restrictions:

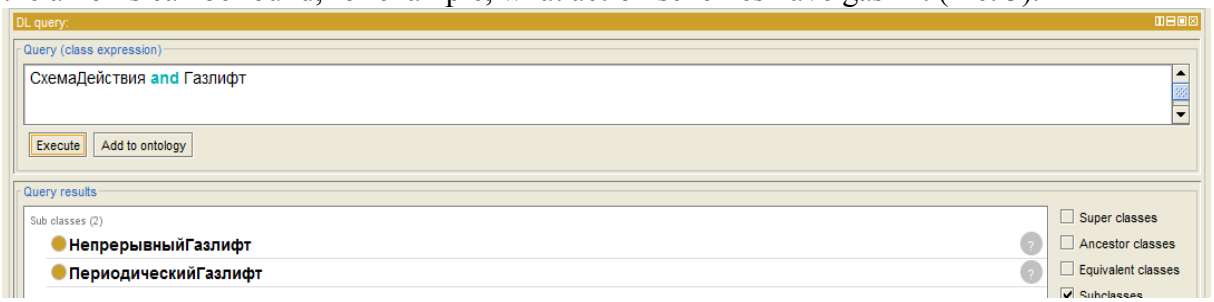
- Existential restrictions describe a class of individuals having at least one (some) the ratio of the specified property for the individual who is a member of a given class. Existential limitations suggest the presence of at least one relationship at this property for the individual who is a member of a particular class (specified range);
- Universal restrictions (only) are denoted by ∀. They limit the relationship to this property for the individuals who are members of a particular class;
- Restrictions power (exactly) indicates the exact number of limitations that describe so classes are known as power limits;
- Minimum power limit (min) specifies the minimum number of relationships that an individual may have;
- The maximum power limit (max) is the maximum number of relationships that an individual can have.

For example, for the field of "Oil Production" by gas lift action scheme offers the following axioms (Pic. 2).



Picture 2 - Quest of axioms (constraints)

Based on certain axioms can be queried to retrieve the required knowledge. Based on the axioms can be found, for example, what action schemes have gas lift (Pic. 3).



Picture 3 - The request and its result

Working with ontological knowledge base involves the use of rules of inference. For this purpose, there is a special tool - block inference (reasoner). This subsystem allows Protégé verify the truth, falsity or uncertainty of some axioms within a given ontology. He also used to construct a complete set of axioms based on the existing ontology and output implicit knowledge of the subject area.

Since the ontology not only includes a glossary of terms and concepts in the domain , but also logical expression (communication) , describing the relations with each other, then it is considered a special kind of knowledge base that can be used independently within the subject area [2]. To use it, the user must formulate a request from the existing knowledge base of concepts and relationships between them, translating it to the formal language of logic, and get

a definite answer, if one exists. Algorithm for creating axioms can be represented as an activity diagram shown in pic. 4.

Picture 4 - Method for creating Inquiries

Tab allows you to receive information query from the project across all instances of classes that meet the criteria of interest. You can also save searches the library for future use. To create a query, you must select one or more classes and a few slots in the class. It is possible to save searches the library for future use.

Formed ontology of oil production facilities allows logical requests to acquire new knowledge in this area. The result can be presented in the form of new facilities as a result of the visual analysis of the structure domain, or as the results of the semantic query.

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APPLICATIONS OF FUZZY SETS THEORY IN MANAGEMENT PROBLEMS ANALYSIS

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The paper focuses on the applications of fuzzy logic approach to analyzing and solving management problems. The research has specified a method to decision-making and evaluation based on fuzzy sets theory. The method uniforms qualitative and quantitative schemes of evaluation and is suitable for integrated assessment to fulfill organization needs in operations.

Keywords: fuzzy logic, fuzzy sets theory, management analysis, decision-making.

The discussion of possible applications of fuzzy sets theory in management problems analysis should begin with the short introduction to the fuzzy sets theory framework. The core of fuzzy sets theory was introduced by Zadeh in his 1965 paper [1]. Zadeh's latter works [2, 3] proposed some concepts of linguistic variables and its applications in fuzzy logic systems (FLS). One of the most appealing advantages of fuzzy assessment in management is the possibility to use linguistic variables, which provide a natural way for humans to express judgments.

The key ideas and terms of fuzzy sets application are introduced below.

Non-crisp sets are called *fuzzy sets*, for which also a characteristic function can be defined. This function is called a *membership function*.

The membership of a fuzzy set is described by this membership function $\mu_A(x)$ of A, which associates to each element $x_0 \in X$ a grade of membership $\mu_A(x_0)$. The following notation for the membership function $\mu_A(x)$ of a fuzzy set A is used: $A : X \rightarrow [0,1]$. Each fuzzy set is completely and uniquely defined by one particular membership function (Figure 1).

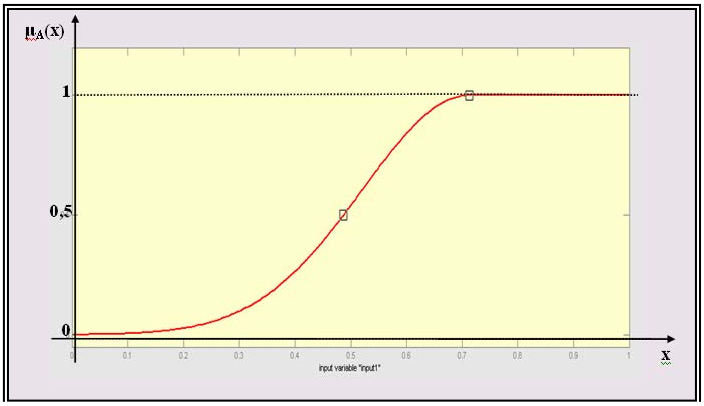

Figure 1 – A membership function $\mu_A(x)$

The *support* of a fuzzy set A is the crisp set that contains all the elements of X that have nonzero membership grades in A, i.e. $supp(A)=\{x \in X \mid \mu_A(x)>0\}$

A *fuzzy set* A is called *normal* when the largest membership grade obtained by any element in that set is equal 1.

The *core* of a normal fuzzy set A is the crisp set that contains all the elements of X that have the membership grades of one in A, $core(A)=\{x \in X \mid \mu_A(x)=1\}$.

The *boundary* is the crisp set that contains all the elements of X that have the membership grades of $0<\mu_A(x)<1$ in A, i.e. $bnd(A)=\{x \in X \mid 0<\mu_A(x)<1\}$.

The Figure 2 illustrates the key characteristics of the membership function $\mu_A(x)$.

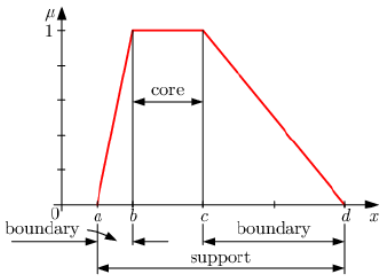

Figure 2 – Characteristics of a membership function $\mu_A(x)$

Fuzzy number means a fuzzy set *A* defined on the basis of real numbers *R* with the following characteristics:

1. A is convex i.e., $\mu_A(\lambda x_1+(1-\lambda)x_2)\geq min(\mu_A(x_1),\mu_A(x_2))\ \forall x_1,x_2 \in R,\ \forall\lambda \in [0,1];$
2. A is normal;
3. μ_A is piecewise continuous [4];
4. Fuzzy Scale.

Assume that the fuzzy numbers $T_1 \ldots T_n$, defined in the interval <A, B> make fuzzy decomposition of interval (A, B) if:

$$\forall x \in (A,B): \sum_{i=1}^{x} T_i(x) = 1$$

Fuzzy scale is a set of fuzzy numbers $T_1 \ldots T_n$ defined in the interval <A,B> and make a fuzzy decomposition of this interval that are numbered according to their order.

Linguistic scales meet the properties logically expected from undetermined linguistically defined scales: meaning of linguistic values are ordered linearly; each point of the interval either entirely pertains to certain of the linguistic scale values, or its pertaining is divided between two succeeding values in the language scale (where the core of a fuzzy number ends, the support of a following fuzzy number begins, and with the beginning of the core of this fuzzy number, the support of the previous fuzzy number ends); meanings of language values are modeled with fuzzy numbers with related membership function [5].

For some applications the modeling requires continuously differentiable curves and therefore smooth transitions. As examples, the following functions are possible: the normalised Gaussian function (a), the difference of two sigmoidal functions (b), the generalised bell function (c) (Figure 3).

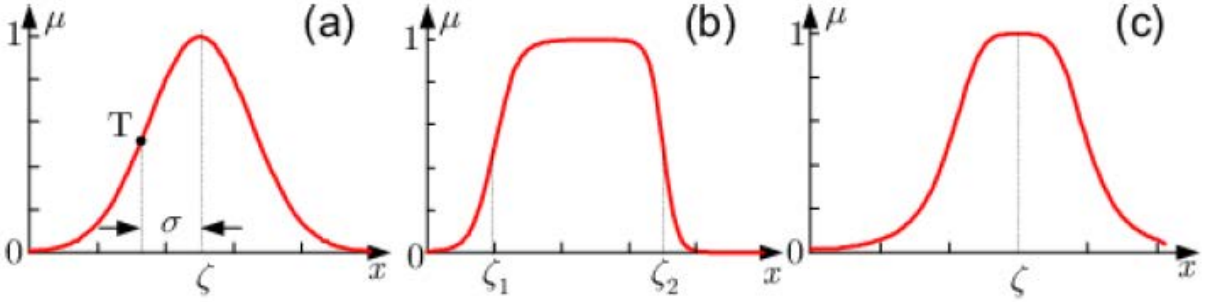

Figure 3 – Membership functions with smooth transitions

These curves have the advantage of being smooth and nonzero at all points, on the other hand, they are unable to represent asymmetric membership functions, which might be crucial for some applications.

Thus, we have embraced fuzzy sets theory. Further, we aim to find possible applications of this approach to management problems, such as decision-making and evaluation. For this purpose, we need to outline key steps needed to perform, when using linguistic scales and fuzzy sets theory for evaluation. Some recent researchers propose quite similar list of consecutive steps [6]. Based on them, we introduce our own scheme of the following steps:

1. Form a group/committee of decision-makers (evaluators).
2. Identify criteria for a management project evaluation.
3. Identify projects and collect relevant data on them.
4. Derive a linguistic scale for evaluation and a respective membership function.
5. Perform the evaluation.
6. Aggregate evaluation results as fuzzy numbers.
7. Defuzzification: transform fuzzy numbers into crisp ones.

The each step should describes different aspects of designing the considered artefact's component:

- justifications for the step (why the step is needed),
- what alternatives and other options were considered if any, when specifying the step,
- why the final, solution was chosen over other alternatives with references to the requirements for the artefact.

The steps, proposed by the authors, are seen as main blocks or components of the artefact. Without digging into details the key steps to take are highlighted as follows: identify alternatives, identification of criteria, taking stakeholders into account and handling external and internal uncertainty.

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USING MULTI-RESOLUTION ANALYTICAL DIGITAL MAP MODEL IN AIRBORNE GEOGRAPHIC INFORMATION SYSTEMS

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In this paper a method to store metrics of extended polygonal and linear digital map features is shown. The method is based on the presentation of feature contour line as a set of approximations. The simplified contour of a feature is represented by low-level approximation. Detail coefficients provide information to "dynamically" reconstruct the shape of a feature at any level of detail.

Keywords: digital map, airborne geographic information solution, digital map model, level of detail, wavelet transform.

The crews of modern aircraft have to analyze a lot of information during the flight, must have accurate and reliable information about aircraft position, position of reference points, landmarks and terrain, and also must be aware of factors crucial for flight safety, precision navigation and combat effectiveness. That's why airborne geographic information solutions (AGISs) become the "de facto" standard for electronic equipment of modern and future aircraft.

In recent years, the developers of ground-based geographic information systems and airborne digital map systems gained serious experience, as well as the manufacturers of modern electronic components showed significant improvement. Nevertheless, the implementation of

geographic information technologies onboard an aircraft usually faces many problems and may require a non-trivial solution.

As a matter of fact, the technique for developing AGIS is based on three key components: information resources – onboard spatial database(s), methods of retrieving data from these information resources – spatial database management system, and target functionality – geographic information applications (tasks), which run as a part of the whole onboard computing environment (information and control system) of the aircraft. Methods of implementation of the first component largely determine the whole onboard spatial data infrastructure.

Modern AGISs assume to have built-in methods of situation adaptation of digital cartographic information [1], which is why the structures of spatial databases are often designed to provide "dynamic adjustment" of level of detail (LOD) of spatial information used for solving target tasks.

The proposed analytical digital map model is based on representation of information about map features as a set of successive approximations, which are a rough component at the lowest possible LOD, and a set of detail coefficients for the higher LODs. Such a representation of the original data can be obtained by expansion in the basis of special mathematical functions – wavelets – through discrete wavelet transform (DWT). Both the rough component at the lowest LOD and detail coefficients at higher LODs are stored in a database onboard an aircraft. If any of airborne geographic information applications should fetch this data at the required LOD, first, the rough component and then the required number of detail coefficients are retrieved from database. After reconstruction process is preformed, restored digital map information are transferred to the application.

Decomposition of source data by the use of DWT can be represented as a tree of low- and high-pass filters [2]. The filters are specified by matrices of wavelet coefficients **L** (low-pass) and **H** (high-pass). Generally, DWT can be represented as following:

$$\begin{bmatrix} \mathbf{a}_{m-1} \\ \mathbf{d}_{m-1} \end{bmatrix} = \begin{bmatrix} \mathbf{L}_m \\ \mathbf{H}_m \end{bmatrix} \mathbf{X}.$$

Here:

$$\mathbf{X} = \begin{bmatrix} \langle x_1, y_1 \rangle \\ . \\ . \\ \langle x_{2^m}, y_{2^m} \rangle \end{bmatrix}, \quad \mathbf{a}_{m-1} = \begin{bmatrix} a_{m-1,0} \\ . \\ . \\ a_{m-1,2^{m-1}-1} \end{bmatrix}, \quad \mathbf{d}_{m-1} = \begin{bmatrix} d_{m-1,0} \\ . \\ . \\ d_{m-1,2^{m-1}-1} \end{bmatrix},$$

where $\mathbf{X}$ – is a column vector of the original signal with 2^m pairs of coordinates; $\mathbf{L}_m$, $\mathbf{H}_m$ – filter matrices size of $2^{m-1} \times 2^m$ elements; $\mathbf{a}_{m-1}$ и $\mathbf{d}_{m-1}$ – column vectors of approximation and detail coefficients, respectively, with 2^{m-1} elements. We should apply low- and high-pass filters to $\mathbf{a}_k$ until achieving the required LOD. The resulting DWT $\{\mathbf{a}_k, \mathbf{d}_k, \mathbf{d}_{k+1}, ..., \mathbf{d}_{m-1}\}$ consists of 2^m elements and should be stored in a database.

The inverse DWT (IDWT) can be represented as follows:

$$\mathbf{a}_k = \begin{bmatrix} \mathbf{L}_k \\ \mathbf{H}_k \end{bmatrix}^{-1} \begin{bmatrix} \mathbf{a}_{k-1} \\ \mathbf{d}_{k-1} \end{bmatrix}.$$

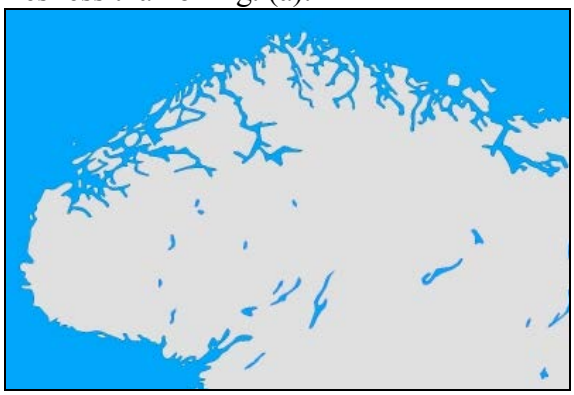
The IDWT filter matrix can be represented as follows:

$$\left[\frac{\mathbf{L}_k}{\mathbf{H}_k}\right]^{-1} = \left[\mathbf{L}_k^T \mid \mathbf{H}_k^T\right],$$

the step of the IDWT can be represented as follows:

$$\mathbf{a}_k = \left[\frac{\mathbf{L}_k}{\mathbf{H}_k}\right]^{-1}\left[\frac{\mathbf{a}_{k-1}}{\mathbf{d}_{k-1}}\right] = \left[\mathbf{L}_k^T \mid \mathbf{H}_k^T\right]\left[\frac{\mathbf{a}_{k-1}}{\mathbf{d}_{k-1}}\right] = \mathbf{L}_k^T\mathbf{a}_{k-1} + \mathbf{H}_k^T\mathbf{d}_{k-1}.$$

The figures below show examples of reconstruction of the coastline of the **Scandinavian Peninsula** with different LODs: fig. (a) – the maximum LOD, fig. (b) – two levels lower than the maximum LOD. The accuracy of coastline representation on a map at this scale is almost the same, though the number of points of the coastline contour on fig. (b) is four times less than on fig. (a).



a

b

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INITIAL RESOURCE PROVISIONING IN IAAS CLOUDS BASED ON THE ANALYTIC HIERARCHY PROCESS

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The aim of this paper is to describe one possible solution of a problem of efficient initial resource provisioning in the Infrastructure-as-a-Service cloud environments. The analytic hierarchy process has proven to be effective in this case and the steps have been defined to apply this method to the cloud specific.

Keywords: resource provisioning, cloud computing, IaaS, analytic hierarchy process.

Cloud environments based on the Infrastructure as a Service (IaaS) model become more popular all over the World nowadays [1,1]. This is caused by multiple factors:

1. CAPEX reduction:

− infrastructure savings. Cloud computing can help companies standardize the hardware means being used by giving priority to less expensive thus less reliable hardware. What makes it possible is the decrease in importance of each infrastructure component required to meet the availability requirements. Moreover, Software-Defined Networks (SDN) might enable companies to avoid the purchase of expensive network equipment and use cheap L2 switches;

− license savings. In cloud environments, the companies are often able to use free hypervisors, software storage solutions and management components;

− savings on the cloud expansion. IaaS clouds are built in a way that they can be scaled horizontally using similar «building blocks». Also, those building blocks can be upgraded easily in time.

2. OPEX reduction:

− staff savings. Because the processes of resource provisioning, distribution, growing and shrinking a cloud are automated, much less labor expenses are involved in maintenance and technical support of the cloud in comparison with traditional infrastructures and virtual environments.

Considering the benefits given above, even more companies choose the IaaS model as the initial design pattern of their new computing systems both for internal use and for providing services.

Therefore, very different systems can be placed into a cloud – from an unstressed website to high-stressed databases, ERP systems etc. Obviously, those systems have absolutely different requirements for each type of computational resource, so it is completely wrong to place them on the same hosts, storage devices and network segments. This will lead to misallocation, performance problems and additional expenses.

In [3,3] author has proposed the mechanism that allows solving the problem of proportional load balancing among all the hosts and storages of the cloud considering they have different performance and capacity. The method is aiming to provide the most efficient utilization of existing cloud resource and ensure the best conditions of applications' work at the same time. The method consists of two phases: initial resource provisioning and dynamic resource redistribution [3,3].

The case examined in the research paper is the way of initial resource provisioning in an IaaS cloud that helps optimize the existing resource usage thus minimize the probability of further resource redistribution (P_{redist}). Or P_{redist} -> 0.

Existing approaches to initial resource provisioning in a cloud

The initial resource provisioning approaches that exist as applied to cloud environments can be divided into 3 types: manual provisioning, provisioning by cloud scheduler and provisioning by virtual environment [3,1].

In case of provisioning by cloud scheduler, there are algorithms of random selection, alternate provisioning and selection of the host with the least processor load.

In case of provisioning by virtual environment, the methods of Distributed Resource Scheduling (DRS) and Distributed Power Management (DPM) are usually used.

The drawback of each method listed is that the requirements of the applications run inside instances (virtual of physical servers delivered as-a-service) are considered only in context of the CPU, memory and storage resource required. Neither the specific of the application load, nor the influence of sharing resource with other instances on the same hosts are considered. As a result, the optimal resource for initial placement is often chosen

incorrectly, that leads to significant application performance degradation and efficiency of utilizing the cloud resource.

Problem solution with the analytic hierarchy process

The analysis has shown that the problem is multicriterion and thus can be solved with the analytic hierarchy process. The analytic hierarchy process is being successfully used in various fields of science to solve similar problems [2,3] but due to several features of the problem posed it requires execution of several preliminary steps that take into account the specific of cloud environments:

1) the cloud environment is decomposed into the zones, each includes hosts and storage resource with the similar characteristics;

2) the appropriate zone is chosen considering the limitations made towards the instance (number of CPUs, memory amount, storage volume etc.);

3) quality metrics assessment is being conducted for each host and storage included in the zone selected;

4) selection of the most appropriate host based on the alternatives analysis.

Each phase is described in detail further.

On the first phase the cloud environment is divided into zones based on particular qualities of the resources provided in each zone (Figure 1). For example, a cloud can be divided into the zones of high load (eight core servers, 40 Gb network, High-End storage), medium load (four-core servers, 10 Gb network, Midrange storage) and low load (to cross sell servers, gigabit network, local discs). This will help simplify the solution of the task in a way that an instance will initially start in the zone that will most likely satisfy its initial requirements (number of CPUs, RAM, Storage). The selection is done using simple logical expressions.

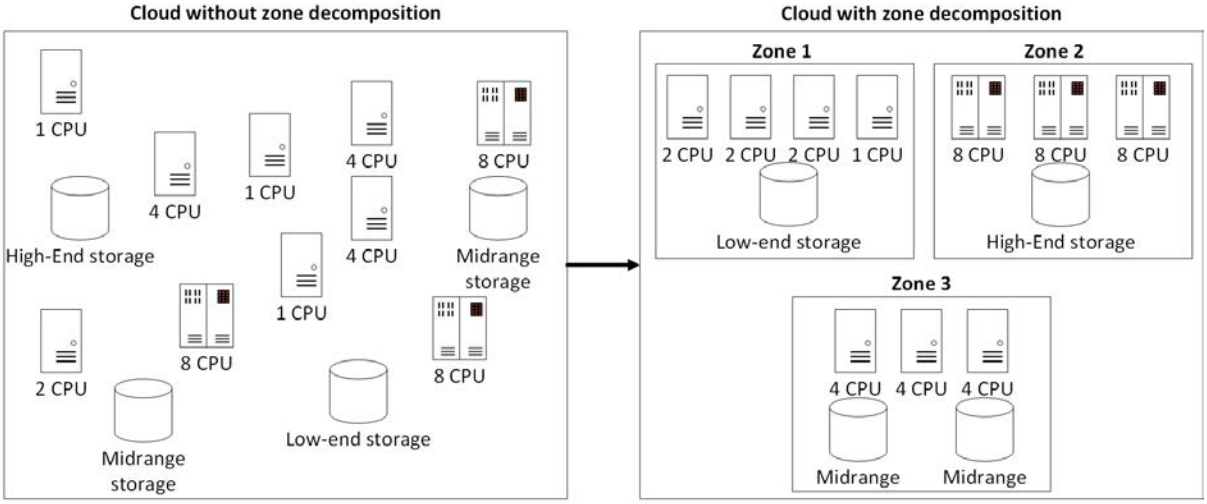

Figure 1. Cloud decomposition into zones (phase 1)

The second phase is selection of a zone appropriate for the instance upon its requirements (Figure 2). Using zones allows us to consider the limitations of characteristics of an instance in order to place it on the host and the storage with enough source to run applications inside the instance.

On the third phase a set of quality metrics is collected for each host of the zone determined on the previous phase (Figure 2). These quality metrics describe functioning of host and its subsystems. The primary host quality metrics are as follows:

1. Performance;
2. Reliability;
3. Load.

The primary metrics given can be decomposed into a set of particular metrics:

1. Number of CPU (N_{CPU}) – performance;
2. Number of CPU cores (N_{cores}) – performance;
3. Clock rate (V_{CPU}) – performance;
4. Free RAM (R_{free}) – load;
5. CPU load (L_{CPU}) – load;
6. Disk subsystem load (L_{disk}) – load;
7. Disk subsystem latency (T_{disk}) – performance, load;
8. Network speed (V_{net}) – performance;
9. Network load (L_{net}) – load;
10. Number of running instances (N_{inst}) – load;
11. Host work time (T_{work}) - reliability;
12. Administrative weight (A_{adm}) - reliability.

The totality of particular metrics that influence the complex quality metric can be conjugated into two groups: determined (connected with the configurations of the equipment) and stochastic (connected with the load and work time). One more group of metrics can be added – the so-called fuzzy metrics or metrics based on the linguistic variables.

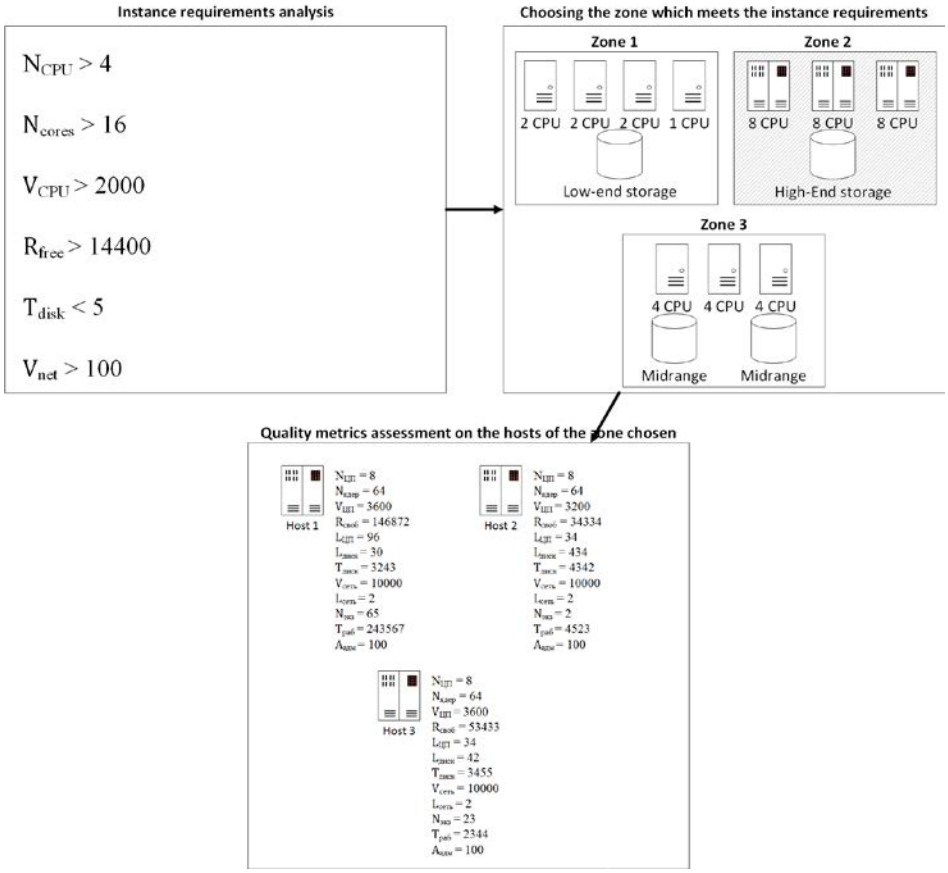

Figure 2. Choosing the zone that meets instance requirements and quality metrics assessment (phases 2, 3)

On the fourth phase an analysis of the alternatives based on the quality metrics is conducted in order to select the most appropriate host for placing an instance (Figure 3). Each metric has its own weight for each zone defined in expert way upon the generalized clients requirements and existing equipment. As a result, the instance is placed onto a host that has the least generalized Predist metric, i.e. providing the least probability of redistribution, which must use the same set of metrics.

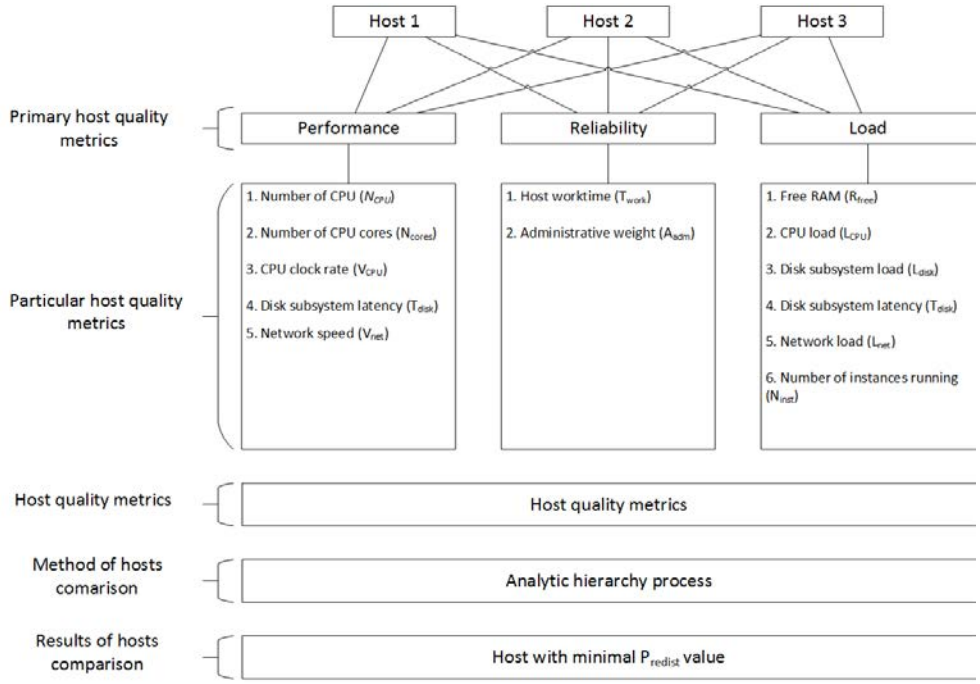

Figure 3. Finding the host with the minimal Predist (phase 4)

Because quality metrics of each host change in time, the analytic hierarchy process makes it possible to select the best location of an instance during its start. Thus, the proposed solution will help improve the efficiency of resource allocation and its further utilization increasing effective capacity of the cloud. Moreover, the problem of provisioning applications with big differences in systems requirements will be solved due to using zones. The method also makes it possible to significantly reduce the volume of further resource reallocation, lowering the expense of computational resource for this process.

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INTRA-SYSTEM EMC: STATE, PROBLEMS AND TRENDS

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Intra-system EMC evolution problems, new high speed and high sensibility systems trends are considered. General problems solutions are considered. EMC specialists training need is pointed.

Keywords: electromagnetic compatibility, electronic equipment, shielding, signal integrity.

Different system interaction is one of the most interest technical problems, because current electronics development process makes more new tools application result dependencies on its interaction conditions.

At early electronics evolution stages interaction tasks solved generally by circuit design improvements and frequency band planning. At present time individual measures are unsufficient and it is system level problem. EMC requirements must be taken into account at all stages of telecomm and electronic equipment live cycle. We must not divide equipment design problems from its compliance supply problem at service stage. If we ignore EMC problems until they leads to equipment interaction malfunction, then EMC requirements providence will be costly and unsatisfactory.

With high speed digital processing systems and methods development, intra-system design problems became actual. Background for this changed are mandatory EMC certification of electronic devices, high amount of newly designed electronics, increase of electronics performance. All of that factors enhance EMC problems. Furthermore electromagnetic (EM) environment has changed in modern world. The most power RF interferences sources are : nuclear air burst EM pulse, lightnings, geomagnetic storms, high voltage (HV) power lines, railways, HV equipment, power RF transmitters, radars, ultra wide band EM pulse sources, microwave transmitters.

For this environments the following intra-system EMC trends and problems may be pointed. It is need to analyse strong EMI sources to identify radiated EM fields strength. RFI and operating frequency band enhancement requires most adequate processes and equipment models in RF domain. These models must be suitable for design solution verification. It is need to develop special software for those factors evaluation as following: signal integrity, shields efficiency, shield interruption taking in account, EMI emission level, virtual certification tests etc.

It is need to review bachelors, masters and postgraduates training courses in field of radioelectronics design and technology and in other connected fields. It is need to include a number of inter-system EMC training courses. At present times EMC is included in some curriculum, but the most of time is dedicated to inter-system EMC problems. Because engineers intra-system EMC skills are unsufficient, they seeks ways how to improve their EMC skills. New equipment EMC specification requires designers to consider intra-system EMC problems. Deadlines, functional safety and project costs depends on these problems solution. The functional safety problem became one of the most critical, for objects under EM emissions influence. This field solutions are now theoretically based.

Inter-system EMC becomes one of the bases in electronic equipment design, and the most important factor (excluding electrical safety) at production release stage. EMC Technical rules of Customs Union juridically bases EMC problems in Russian Federation, that requires more attention to intra-system EMC.

IMPROVING THE ACCURACY OF SOUND DIRECTION FINDING BY YHE GROUP OF MOBILE ROBOTS THROUGH INFORMATION REDUNDANCY

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The article deals with the problem of determining the origin of the sound source in a information redundancy conditions. This problem arises at spatial localization of a source of a sound by group of the mobile robots equipped with binaural systems of technical hearing. The paper discusses two approaches to solving this problem: the formulation of necessary conditions of an extremum of square functional and then solving of the received non-linear system of the equations and numerical methods of the gradient minimization. The paper presents the results of numerical studies based on these two approaches.

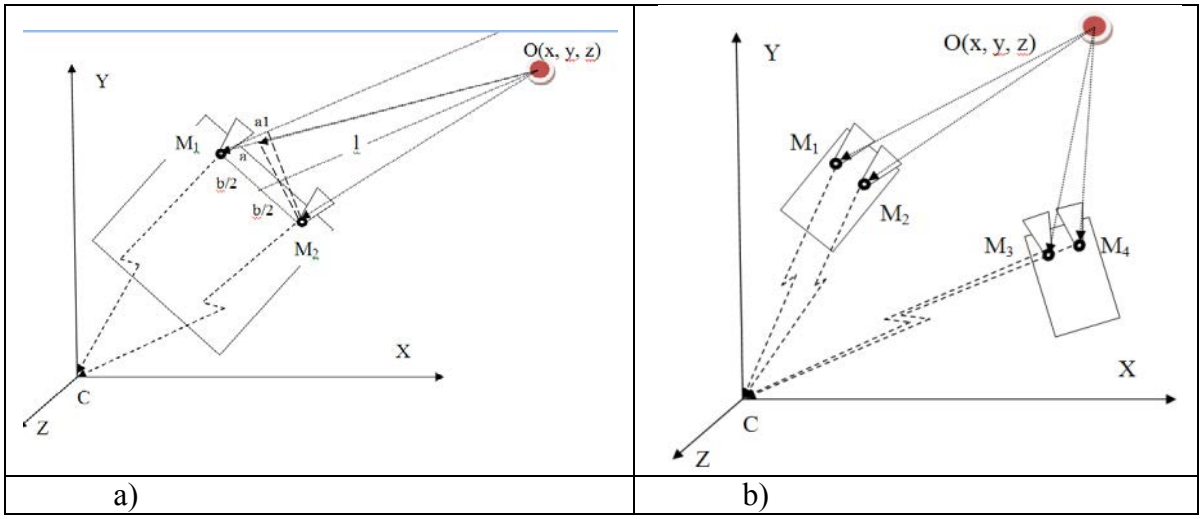
Keywords: group of mobile robots, coordinates of sound source, information redundancy, Newton's method, steepest descent method.

Among the highly topical issues of fundamental and applied research there is the development of Multimedia Intelligent Network of Unattended Mobile Agents or «Minuteman». This topic is the subject of large-scale studies and to implement this idea in the developed countries (USA, Japan, Russia, and China) attracted large groups of scientists at the leading universities [1 - 3].

Advantages of group applications of intelligent robots are obvious: a joint performing of common operations which is coordinated in space and time, longer range, extended set of functions performed the higher probability of the successful task completion achieved by allowing goals redistribution between robots groups in case some of them fail.

In the papers [1-6] the main problems to be solved by multimedia network of autonomous robots are shown. One of the main objectives of such systems is the passive acoustic analysis of environmental conditions and localization (determination of the coordinates) of the object emitting the certain audio signal.

In [5,6] sound source (SS) localization performed by one of the mobile robot (two-dimensional problem), which has two acoustic receiving antennas on board (system of technical hearing, STH). STH works on the principle of binaural hearing (Fig. 1-a). The problem of determining the coordinates of SS solved by range difference method.



a) b)

Figure 1 – The principle of passive sound location: a) one STH, b) two STH

Figures 1-a and 1-b (and beyond) uses the following notation:

$M_j(x_j,y_j,z_j)$ - *j*-th receiving acoustic antenna with corresponding coordinates for mobile robots with STH of two microphones;

b_i – STH base, *bi / 2* - the distance from the sensor to the host central axis of the robot body (for Fig. 2 - b);

C(0,0,0) – base observation station, the origin of coordinates;

O(x,y,z) – object, sound source (SS).

As shown on Figure 1–a, the time delay of signal coming from M_j to the *j*-th station *C*:

$$\tau_j = \frac{1}{c} \cdot \left(\overline{OM_j} + \overline{CM_j} - \overline{OC} \right), \quad (1)$$

where τ_j – the time delay of signal coming to the station C from receiving antennas, $\overline{OM_j}$ – distance between the SS and acoustic receiving antennas, $\overline{CM_j}$ – расстояния между станциями и пунктом приема сигналов, $\overline{OC}$ – distance between stations and the point of signal reception (base station), $j = \overline{1,n}$ – number of acoustic receiving antennas.

Equations (1) relate the arrival times of the SS signal with the distances between the receiving antennas and station C, the distances between all stations and SS, and with the sound velocity in atmosphere. Distance from SS to stationary monitoring station *C* is determined by the following equation:

$$\overline{OC} = \sqrt{x^2 + y^2 + z^2},$$

and to the receiving antennas M_j by:

$$\overline{OM_j} = \sqrt{(x - x_j)^2 + \left(y - y_j \right)^2 + (z - z_j)^2} \quad (3)$$

The main disadvantage of using a single robot is carrying out additional measurements (STH base rotation or moving the robot). In a dynamically changing acoustic space, quality solution to the problem of one STH is not possible.

Spatial localization of the SS implies at least three receiving antennas and one observation point at which signals delays τ_j are transmitted (Fig. 1 - b).

Expressing the relation (1) in the coordinate position of the stations and the SS, we obtain a system of nonlinear equations, which are known all values except the coordinate position of the SS (x, y, z):

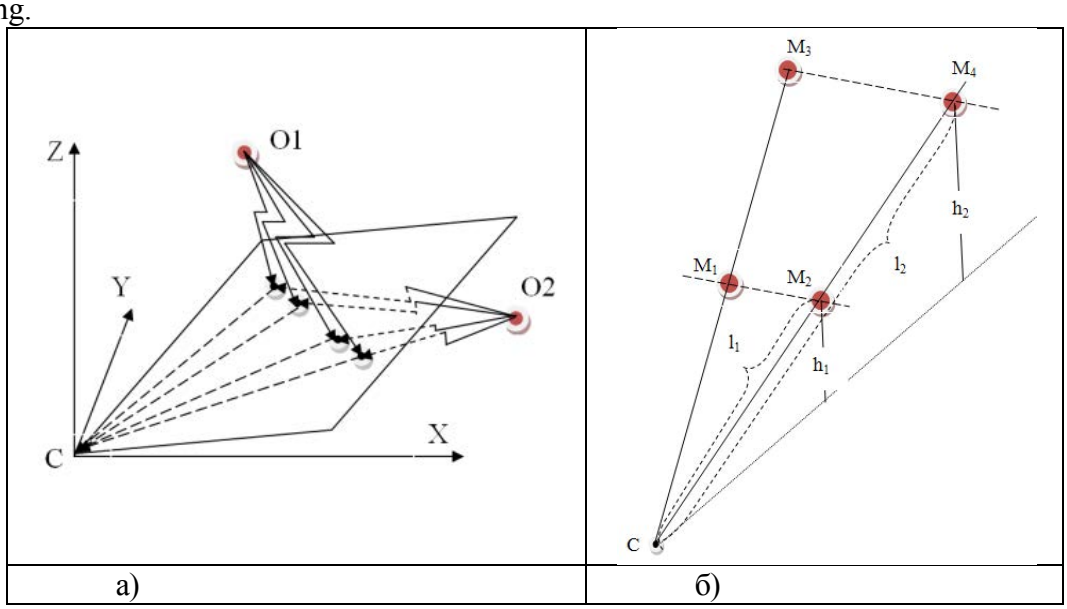
$$F_j(x, y, z) = \frac{1}{c}(\overline{OM_j} + \overline{M_jC} - \overline{OC}) - \tau_j =$$
$$= \frac{1}{c}\left(\sqrt{(x-x_j)^2 + (y-y_j)^2 + (z-z_j)^2} + \sqrt{x_j^2 + y_j^2 + z_j^2} - \sqrt{x^2 + y^2 + z^2}\right) - \tau_j, \quad (4)$$
$$j = \overline{1,n}$$

To find the coordinates of the sound source it is sufficient to solve a system of three equations. The most common method for solving nonlinear equations is the Newton iteration method [7]. This method allows obtaining the solution (4) with a specified accuracy for a small number of iterations.

However, using two STH or a microphone array of three receiving antennas can lead to ambiguity decisions when receiving antennas are in the same plane (see Fig. 2-a and b), the ambiguity is not always have a solution. It should also be noted that the correlation or spectral methods for determining the signals time delay τ_j have a certain error, which also leads to further errors in SS resulting coordinates calculations.

The goal of this work is to obtain a more accurate solution of the problem of determining the SS coordinates through the use of redundant information which occurs when the number of signal delay $n > 3$.

To achieve the goals it is necessary to formulate the problem of determining the coordinates of the mobile robots groups (at least three robots) and to offer effective methods of solving.



а) б)

Figure 2 - The ambiguity of equations solution (4):

a) the height of the robots are same, antennas are located on a circle centered at the stationary point of reception, b) the location of antennas in parallel and proportional to the height of robots ($\frac{h1}{h2} = \frac{l1}{l2}$)

Extreme formulation of determining the sound source coordinates

Consider the problem of determining the coordinates of the mobile robots groups. For convenience of presentation follow we will consider a group of three robots, respectively, of the three STH with two receiving antennas in each. We assume that the base STH identical and receiving antennas in each auditory system are equidistant.

The system of equations for determining the SS coordinates:

$$f_j(x,y,z) = \frac{1}{c}\left(\sqrt{(x-x_j)^2+(y-y_j)^2+(z-z_j)^2}+\sqrt{x_j^2+y_j^2+z_j^2}-\sqrt{x^2+y^2+z^2}\right)-\tau_j = 0, \quad (5)$$

where $j = \overline{1,n}$.

System (5) contains more equations than the number of unknowns, ie $n > 3$.

Let's formulate the task of determining the SS coordinates under redundancy in extreme statement. To do this, we form a quadratic functional, equal to the sum of squares of the residuals of each equation of the system:

$$U(x,y,z) = \sum_{j=1}^{n} p_j f_j(x,y,z)^2, \quad (6)$$

where $j = \overline{1,n}$ и $n \geq 5$, p_j are weights evaluated different accuracy of the time delay signals τ_j.

Then the task of determining the coordinates of a SS is to minimize the quadratic functional (6):

$$U(x,y,z)=\left(\frac{1}{c}\left(\sqrt{(x-x_j)^2+(y-y_j)^2+(z-z_j)^2}+\sqrt{x_j{}^2+y_j{}^2+z_j{}^2}-\sqrt{x^2+y^2+z^2}\right)-\tau_j\right)^2\rightarrow \min,$$

which may be performed based on two approaches.

The first approach is based on obtaining the necessary conditions for a functional extremume (6), which is not difficult to perform for a quadratic functional. The second approach is based on numerical methods gradient minimization.

Necessary conditions for an functional extremum (6) gives the following system of nonlinear equations (7), which is solved by Newton's method.

$$\begin{cases}\dfrac{\partial U(x,y,z)}{\partial z}=0\\ \dfrac{\partial U(x,y,z)}{\partial y}=0\\ \dfrac{\partial U(x,y,z)}{\partial x}=0\end{cases} \qquad (7)$$

Numerical studies of determining the SS coordinates under redundancy

To calculate the SS coordinates we used iterative methods: the steepest descent method (to minimize the functional (6)) and Newton's method (for solving the system of equations (7)) [7]. Each of the methods in this case has some advantages and disadvantages. The method of steepest descent converges for almost all initial conditions, whereas Newton's method in the general case does not guarantee convergence. Methods have a different rate of convergence: linear for the steepest descent method and quadratic rate of convergence for Newton's method. Therefore, near the desired point solution by Newton's method is achieved in less iteration.

Numerical studies were conducted in the Maple system. To solve this problem, the coordinates of robots from Table 1 taken as input. The task of determining the coordinates in terms of redundancy was solved by two methods, and these methods studied various methods of selection of the initial approximation. For the 1st method initial estimates were calculated by the steepest descent, Newton's method and the system of equations (5) for the three equations). The calculation results are presented in Table 2.

As seen from Table 2, the minimum number of iterations necessary for the first approach (based on the necessary extremum conditions). Thus Newton method is used twice, i.e. initial approximation for Newton's method for solving the system (7) were calculated by Newton's method for 3 equations.

Table 1. - Initial data of sensors coordinates

№ experim.	Robot sensor coordinates		
	Robot 1 (x1;y1; z1) (x2;y2; z2)	Robot 2 (x3;y3; z3) (x4;y4; z4)	Robot 3 (x5;y5; z5) (x6;y6; z6)
1	(5,05;0,55;0,3) (5,34;0,60;0,3)	(0,66;4,12;0,3) (0,72;4,36;0,3)	(6,11;6,27;0,3) (6,27;6,11;0,3)
2	(5.25;1.55;0.3) (5.54;1.6;0.3)	(1.66;4.32;0.45) (1.72;4.56;0.45)	(8,25;8,05;0,35) (8,05;8,20;0,35)
3	(2,75;0,55;0,3) (3,03;0,6;0,3)	(0,66;2,52;0,45) (0,72;2,75;0,45)	(2,27;2,32;0,35) (2,46;2,54;0,35)

Table 2. - Numerical studies

№ experim.	(X,Y,Z)	τj (real)	τj (with errors)	1st-pass						2nd- pass	
				Newton's method		Newton's method + Newton's method		Steepest descent method + Newton's method		Steepest descent method	
				Number of	(x,y,z)	Number of	(x,y,z)	Number of iterations	(x,y,z)	Number of	(x,y,z)
1	11,88,6	0,011689 0,012338 0,000083 0,000107 0,005629 0,006064	0,01169 0,01234 0,00008 0,0001 0,00563 0,00606	48	10,95;87,6;5,3	14+22	11,02;88,05;2	14+ 65	10,96;88,03;60	120	10,95;88,03;6,02
1	32,16,3	0,010642 0,011164 0,005514 0,005821 0,001863 0,001596	0,0106 0,0112 0,0055 0,0058 0,0019 0,0016	62	31,93;15,94;2,9	13+32	32,07;15,97;35	13+ 56	32,05;15,96;3,01	90	32,05;15,96;3,01
2	11,88,6	0,009907 0,010554 0,000418 0,000419 0,001984 0,002293	0,0099 0,0105 0,0004 0,0004 0,0019 0,0022	62	10,94;87,92;5,8	9+28	10,93;88,08;57	9+ 64	10,96;88,05;5,98	108	10,96;88,05;6,02
2	32,16,6	0,000297 0,000338 0,003929 0,004229 0,002337 0,002669	0,0002 0,0003 0,0039 0,0042 0,2337 0,0026	46	31,95;15,94;5,7	10+28	31,94;16,07;53	10+ 46	32,04;16,05;6,01	72	32,02;16,05;6,01
2	8,10,1	0,001962 0,002202 0,002712 0,002987 0,001521 0,002046	0,0019 0,0022 0,0027 0,0029 0,0015 0,0020	36	7,98;9,94;0,9,9	8+12	7,98;10,04;1,1	8+62	8,03;10,04;1,03	128	8,04;10,05;1,01
3	11,88,6	0,005661 0,006261 0,000109 0,000129 0,001896 0,002293	0,0056 0,0063 0,0001 0,0001 0,0019 0,0023	56	10,97;87,91;5,8	16+44	10,97;88,06;55	16+44	11,05;88,04;6,04	130	11,05;88,04;5,98

3	32,16,6	0,000311 0,000348 0,002756 0,002706 0,000566 0,000482	0,0003 0,0003 0,0027 0,0027 0,0005 0,0004	48	31,96;15,95;5,6	14+24	31,93;15,06;69	14+ 34	32,05;16,03;6,02	60	32,05;15,97;6,03
3	8,10,1	0,001141 0,001296 0,001856 0,001803 0,000009 0,000006	0,0011 0,0012 0,0018 0,0018 0,0001 0,0001	56	7,97;9,96;0,99	10+27	7,91;9,85;1,01	10+ 68	8,04;10,01;1,03	120	8,02;10,05;1,01

Conclusions

The paper considers the optimization problem of determining the coordinates of the sound source by group of mobile robots in the conditions of redundancy. Considered two approaches to this problem: the formulation of necessary conditions for an quadratic functional extremum with the subsequent decision of non-linear systems of equations by Newton's method and application of a numerical method to minimize the gradient - the steepest descent method.

The results of numerical studies have shown that the smallest number of iterations is achieved by using the first approach and the Newton method for solving the resulting nonlinear system. Also the numerical studies carried out based on the use of two approaches: first estimates for the system (6) is found by solving the system of equations (7), the second a combination of methods is based on three equations of system (5) by Newton's method and further the solution of (7) by Newton's method, but for the six equations. The results showed that the smallest number of iterations computation is achieved by the combined Newton's method approach for the three and six equations.

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ANALYSIS OF WORK OF INFRA - LOW FREQUENCY HARMONIC OSCILLATOR

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The results of mathematical modeling of the equivalent circuit of a powerful generator of sinusoidal oscillations infra-low frequency. Shows the time dependence of the stresses and parametric currents and powers, allowing to perform the calculation scheme and selection of its elements.

Modern technologies are widely used infra - low frequency vibrations. These technologies are used in metallurgy (metal mixing crucibles), geophysics (exploration) [1,2], energy (diagnostics of electrical cables), medicine (diagnosis, physiotherapy). Frequency range of these fluctuations - from a few hertz to a fraction. For example, when testing high-voltage cables and degauss need 1-0,05 Hz frequency. For transmission infra low frequency oscillations cannot be applied to the load conventional transformers. For this purpose, various ways of converting these vibrations largest stresses.

This article describes the formation of low-frequency oscillations necessary infrastructure through the use of piezoelectric amplitude (PEP) and magnetostrictive electromechanical converters (SMEs) in solving a wide range of applications in engineering, geophysics and oil production. [3] Control panel power and high-frequency ICPs sinusoidal voltage, which is obtained by using a bipolar transistor voltage generator with oscillating circuit.

To improve performance and process quality and supply voltage PEP and SMEs modulate low-frequency sinusoid. Among the existing methods of obtaining such strains become widespread method of amplitude modulation [4]. He carried out very simply: two sinusoidal voltage generator with frequencies F_1 and F_2 are connected in series and are working on a common load. Then the output voltage to obtain two frequencies - one of them, - $F_3 = F_1 + F_2$ and, as a rule, it is not used , and the other $F_4 = F_1 – F_2$ is equal to their difference. It is used for the desired purposes.

Technical realization of such a device is very difficult, because for voltages with a frequency of 1 Hz requires two oscillator frequency, for example, 50 Hz and 49 Hz. Known method - application of digital generators infra bass is quite complicated. Fig. 1 is a schematic diagram of the transistor current generator of high frequency (TCGHF) [5]. By the DC power source V1 is connected transistor bridge (M1-M4). Each half-bridge transistor M1, M3 and M2, M4 is controlled by the control unit V2, V5 and V3, V4, providing key mode transistors. Efficiency such a generator is quite high (95%).

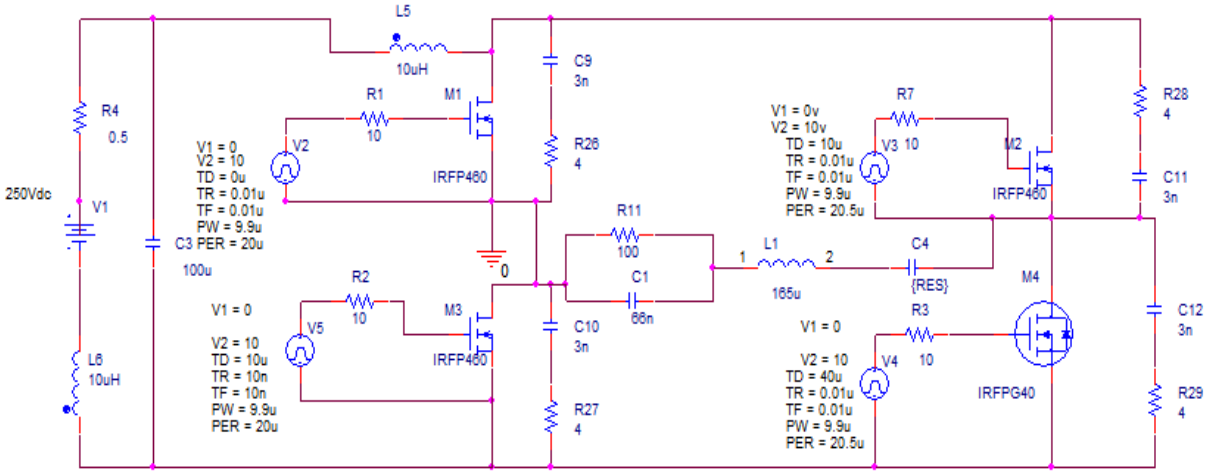


Fig.1. Equivalent scheme LFPG

When both control unit operate at the same frequency, the output voltage generated by the high-frequency rectangular. If the frequencies are different, the output formed by the width -modulated rectangular voltage pulses with amplitude equal to the supply. Then this voltage is applied to filter the first harmonic oscillator circuit formed by L_1, C_1. A capacitor C_1 connected in parallel load R_{11} (R_L) flowing through it and a low frequency sine wave form current with a superimposed high-frequency pulses. For "pure" sine wave demodulator used. In most cases this is not necessary. Thus, at high powers can be used very small high- power transformers in a wide frequency range of the output sine wave. This is a very significant advantage of the proposed scheme.

Also encouraged to include in series oscillating circuit capacitor C_4. Through this, you can either stabilize the output voltage, or adjust it at constant values of the supply voltage and load resistance. To determine the parameters of the oscillatory circuit at a given frequency F1 and the load resistance R_L use the known relations [6]:

$(\omega_0)^2 L_1 C_1 = 1$, where $\omega_0 = 2\pi F_1$ — the resonant frequency of the oscillation circuit L_1,C_1, (1)

$Z_1 = \sqrt{(L_1/C_1)}$ — impedance of the circuit, (2)

$Z_2 = \sqrt{(L_1/C_4)}$ — serial impedance circuit L_1,C_4, (3)

$K_н = R_н/Z_1$ — load factor (4)

With an input voltage of a rectangular (1) can be written

$\pi^2 LC = (t_p)^2$, $t_u = T/2 = \pi/F$ (5)

For the parallel part of the circuit C_1, R_L must specify their value.

Let $R_L = X_c = 1/\omega C$, then, since (1) and (4) we find

$C = t_p / \pi R$ and $L = (t_p R)/\pi$ (6)

A study of low-frequency oscillator circuit voltage infrastructure (LFPG) on a mathematical model. The following experiments were conducted:

1) Change the load resistance at fixed values of the remaining elements of the equivalent circuit.
2) Changing the voltage of the transistor bridge (M_1-M_4).
3) Change the duration of the control pulses at the gates of the power transistors (M_1-M_4).

Table 1 shows the simulation parameters.

Table1 1**:** Circuit simulation parameters LFPG

№	**Name**	**Designation**	**Value**
1	Power Supply (SP)	V_1	250 *V*
	Internal resistance SP	R_4	0,5 *Ω*
	Inductance SP	L_6	10 *μH*
2	Parallel and serial resonant circuits	L_1	165 *μH*
		C_1	66 *nF*
		X_L	0,5 *Ω*
		C_4	50-500 *nF* (ΔC_4 = *50 nF*)
3	Impedance	Z_1	50 *Ω*
		Z_2	55-16 *Ω* (ΔZ_2= 3,8 *Ω*)
4	load Resistance	R_L	50-500 *Ω* ($\Delta R_н$ = 50 *Ω*)
5	Pulse width control	t_p (PW)	9,9 *μs*
6	Cycle time of control pulse	*T*	20 *(21) μs*
7	MOSFET	M_1-M_4	IRFP460 (500 *V*, 20 *A*)

The simulation results are presented in the form of timing diagrams, parametric curves in the pictures below.

For a given frequency switching transistors M_1-M_4 (Fig. 1) determine the frequency of the output voltage. It must be equal $F_1 - F_2$ = 1220 *Гц*. From the diagram (Fig. 2) graphically find frequency sine wave input current, which is equal to 1186 Hz, which practically coincides with the calculation. These charts show that the input current from the power source V_1 is sinusoidal, but it is offset with respect to zero the amount of the constant component of the input current. Fig. 3 shows the timing diagram of voltage across the transistor M1 and the current through.

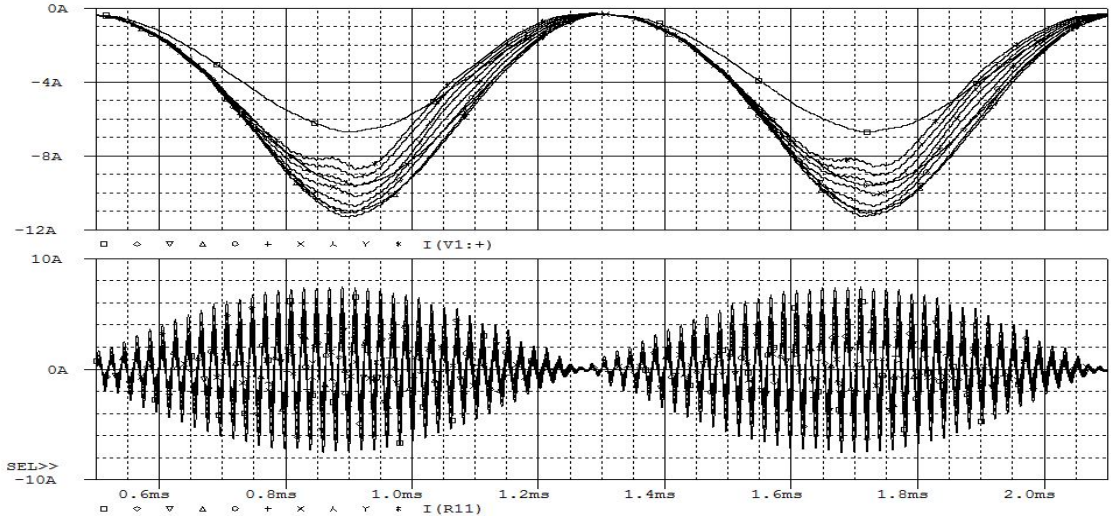


Fig. 2. The timing diagrams of the load current (bottom) and the input current LFPG.

Are important to the design diagram of current and voltage of the power transistor on it

shown in Fig. 3.

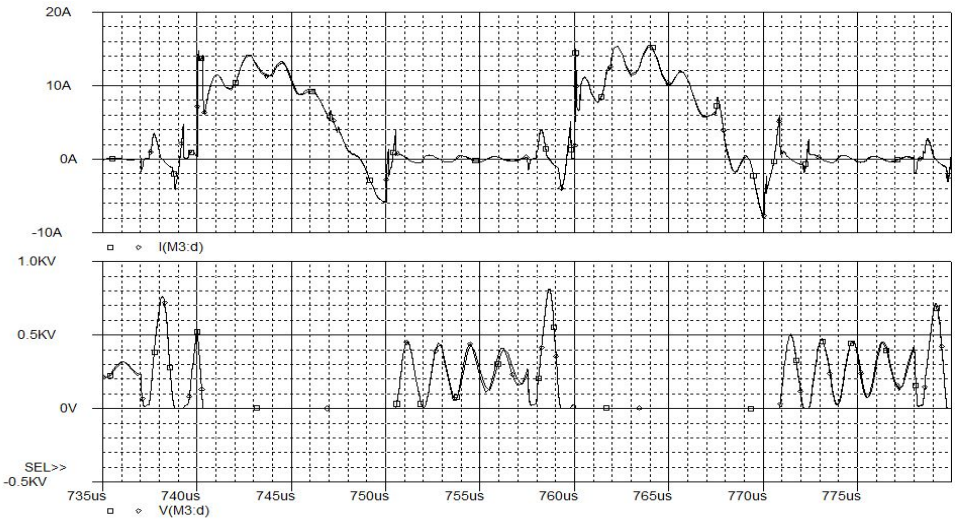
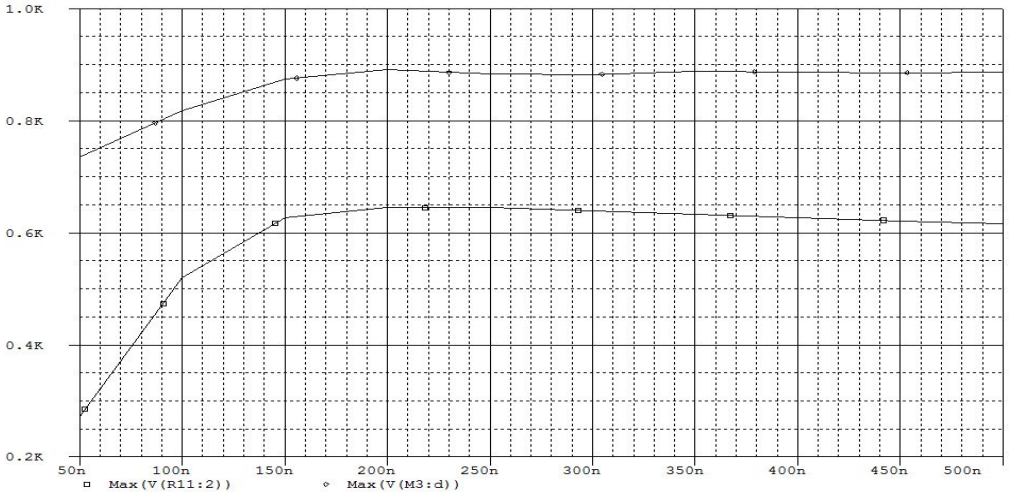


Fig. 3. Timing diagrams current (upper curve) through M1and voltage across it.

Parametric dependence of these quantities on the capacitance of the capacitor C4, are presented in Fig. 4. These dependencies are allowed to select the operating mode LFPG.

It was mentioned above that the experiments were conducted on a mathematical model when the voltage V_1. Data from these experiments suggest that when the input voltage to all voltages and currents vary proportionally. Thus, to increase capacity can be increased LFPG voltage. For example, increasing the supply voltage to two times, all the currents and voltages will increase 2 times, and the power factor of 4.

Very indicative capacities depending active P_L and consumed from the power source V_L and reactive power in the oscillatory circuit (Table 2). It can be seen that the reactive power large (compared to the power in the load), because the energy necessary to provide oscillation processes in the load.



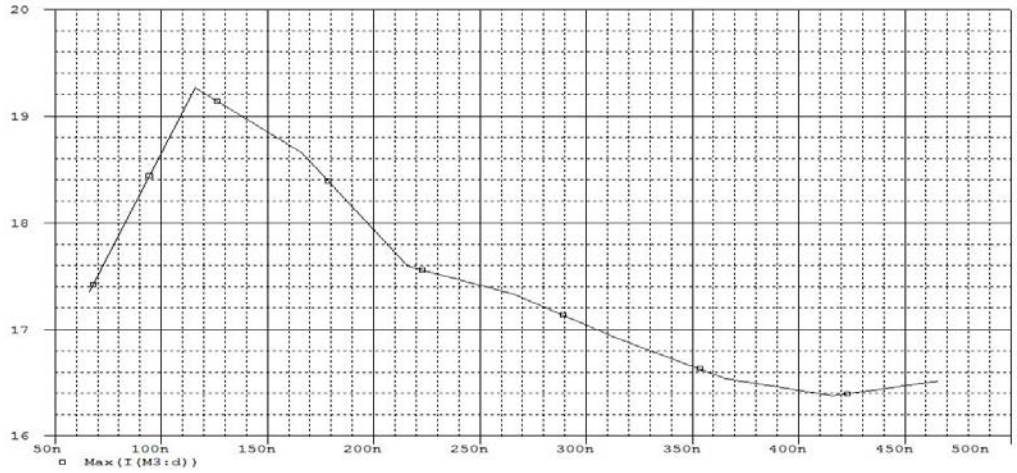


Fig. 4. Parametric dependence of the voltage across the transistor M1 (upper curve), and the load and the current through the transistor M1.

Table 2: The values in the elements of capacity and its efficiency LFPG.

C_4	50	100	150	200	250	300	400	500
$P_н$, *W*	220	800	1300	1500	1500	1450	1380	1240
$P_{вх}$, *W*	310	910	1600	1800	1820	1800	1730	1600
P_L, *VAr*	3750	7800	8700	9000	9100	8900	8500	7900
P_C, *VAr*	1000	3800	4000	4100	4000	3900	3700	3500
η	0,72	0,88	0,81	0,83	0,81	0,79	0,78	0,77

Analyzing the data in Table 2 we can conclude that:

1. The values given in Table. 2 indicate the possibility of regulating the output capacitor value LFPG only C_4, with the magnitude of the supply voltage and the duration of the control pulses of the power transistors remains unchanged.

2. Power inductor L_1 and the capacitor C_4 constitute the significant value, and this naturally leads to an increase in the currents circulating in the circuit LFPG and degrade its efficiency (about 72%).

Conclusion

- The proposed scheme with two oscillating circuit provides a sinusoidal voltage at the output of the infra-low frequency (the output frequency can be higher - up to several hundred Hz).
- The output voltage (and power) can be controlled in three ways: changing the capacitance value series capacitor C_4, change the duration of the control pulses bridge transistors and supply voltage.
- The data obtained allow to design schemes for large capacities. Since modern IGBT transistors produced at currents of hundreds of amperes and voltage up to 2000 volts, and MOSFET transistors connected in parallel and in series.
- It is possible to increase the output power by adjusting the load factor $K_L = R_L/Z_1$.

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AUTOMATED SYSTEM FOR THE ORGANIZATION OF CARGOTRANSPORTATION COMPANY

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The article touches upon the question of creating automated system for cargo Transportation Company and presents the some interesting algorithms of future automated system.

Keywords: Automated system, Transportation Company, Cargo.

At the moment, both in the western and in the domestic market, there are much of software systems (SS), which allows providing inventory control, logistics of Transportation Company (TC), to manage the load on the warehouse and carry out other tasks, however, in most cases, the automated systems management often does not fully cover the entire process of organizing cargo transportation company. So, for example, analysis of systems of this sort showed that in them possibility of an automatic choice of the most optimum way of delivery of freight taking into account such parameters as the cost and time spent for the chosen route isn't considered, in them issues of information security and safety of a cargo transportation also aren't resolved.

Under development automated system (AS) for the organization of cargo Transportation Company should consider the following basic characteristics: the process of receiving the goods to the warehouse; volume measurement; determination of additional parameters for cargo; filling the container cargo with special properties such as: urgency, volume, weight, fragility; preparing crew for cargo delivery; selection of the optimal way to deliver the cargo; delivery of cargo to the customer; solving of emergency situations; providing of cargo security; protection of information about consignee; selection of the optimal delivery method.

For creating an automated system of cargo transportation was developed infological model (pict. 1) which has the following entities:

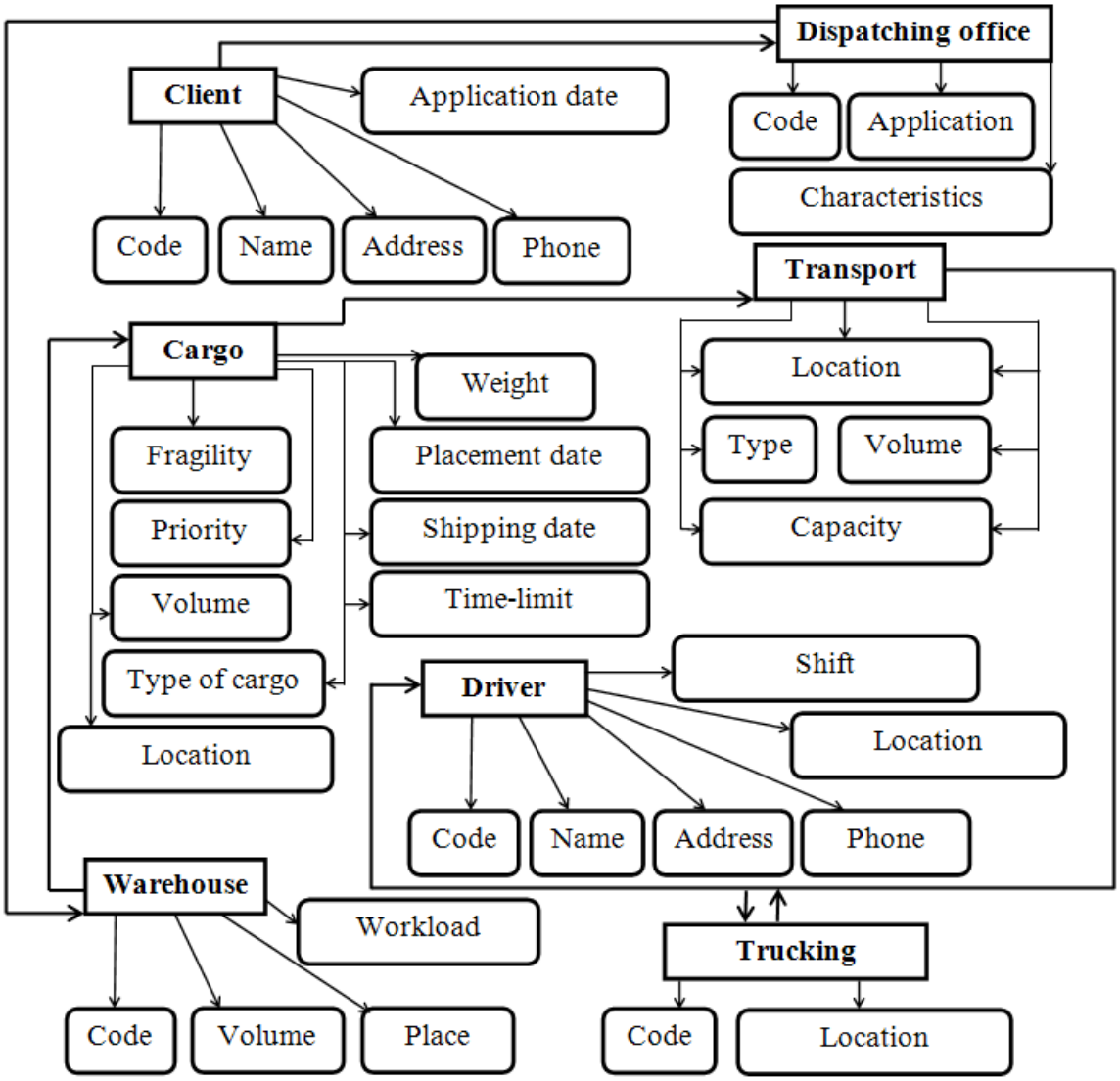
- “Client” is the core entity and has the following attributes: code, name, address, phone, application date;
- “Dispatching office” has the following attributes: code, application, characteristics;
- “Warehouse” is the core entity, has the following attributes: functioning volume, code, volume, place;
- “Cargo” has the following attributes: weight, fragility, placement date, shipping date, time-limit, priority, volume, type of cargo, location;
- “Transport” has the following attributes: location, size, type, load volume;
- “Driver” has the following attributes: change, address, code, name, address, phone number;
- “Cargo transportation” has the following attributes: code and location.

A result of research identifies the main information units which may work as follows. The first stage of the system is forming proposal to cargo delivery according to customer request or for receiving cargo. The process of cargo delivery of any type of cargo can be represented as follows:

Customer goes to TC with a desire to deliver the cargo. Before continuing of order processing is required to receive size and weight of delivered cargo and find out the type of cargo, whether the cargo liquid, bulk or other.

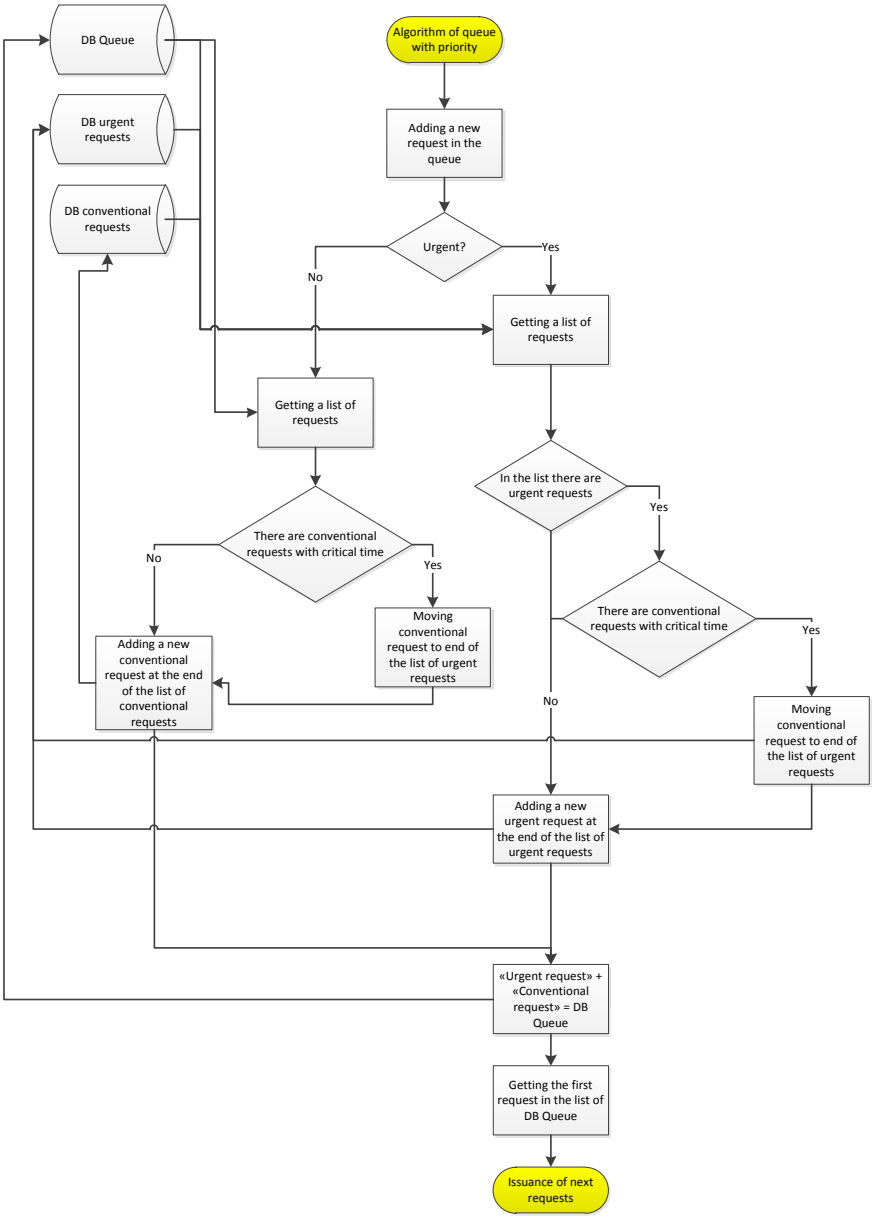
It is required to check possibility of transportation of this type of freight, and also existence of enough of places for its placement in a warehouse. If freight placement in a warehouse is possible and means of TC allow transporting this type of freight, the affirmative answer about freight transportation from the client is expected.

After receiving an affirmative response from the customer about the shipping of the transport company, the database (DB) is formed which will be used in the processing and order fulfillment.



Pic. 1 Infological model

For operation of the all system, it is important to organize job with each request coming into the automated system with the required priorities as well as reduce the length of the queue, because completely overcome it's not possible. For these purposes can be used algorithm of work with requests with priorities which is presented in the pic. 2. In this algorithm is implemented the ability to add new requests with priority, to process old requests and if you have reached a critical time in the requests, it automatically increases the priority for this request. In this algorithm opportunity to add new demands with the indication of their priority, to process old demands and in case critical time according to the demand is reached is realized, its priority will automatically raise that will allow to reduce probability excess of delivery periods of freights and to cut overhead costs of compensation of expenses and penalties of rendering service not appropriate quality.



Pic. 2. Algorithm of queue with priority

For a more complete picture of the operation of this algorithm we will make some clarifications. “DB queue” contains a list of all requests, excluding priority, since priority is given before placing requests into the database. At a later stage of work with this base it will significantly speed up the processing of requests, received from the database. “DB urgent requests” contains a list of requests with high priority, and possible to make sorting through the list depending on the urgency. The data from this database has the highest priority in data processing. Requests which do not have any special priorities are placed in “usual database requests”.

One of the features developed automated system is possibility to work with any type of transport as ships and aircraft. And for each type of transport is essential to use its logistics system for selecting the optimal route based on important criteria for us. It is evident that the route is optimal for road transport is unlikely to be optimal for ships or aircraft. Accordingly need an algorithm that will work with different types of transport and that will determine the most optimal way for the consignment.

Algorithm for determining the type of transport will look like this: checking of all available delivery methods in the transport company. This is required in order to in the event of the company's expansion we can immediately use the new type of transport. Then follows determination what kind of transport is better use for delivering the cargo. Checked every type of transport and determines the optimal way of transportation. This stage should be divided according to the type of cargo.

General or common cargo. Cargo that can be counted, i.e. goods packed in containers or piece goods. Including: boxes, bags, barrels, bales, rolling equipment. General cargo is usually transported packed with list of cargoes at the pack. General cargo must be prepared for transport for avoid any problems. [1]

General cargo typically includes the following types of cargo: containers, rolling equipment, concrete structures, metal, packaged cargo, packaged cargo, timber (round timber, timber).

If freight in the container, is checked opportunity to take away it on motor transport, thus depending on its volume and weight the suitable type of the motor transport is defined. Otherwise, we check possibility of transportation it by rail. If freight, probably to arrange on railway platforms and in the list of transport there is a suitable railway transport, use this type of transport, differently is checked on probably deliveries of this freight by a water transport.

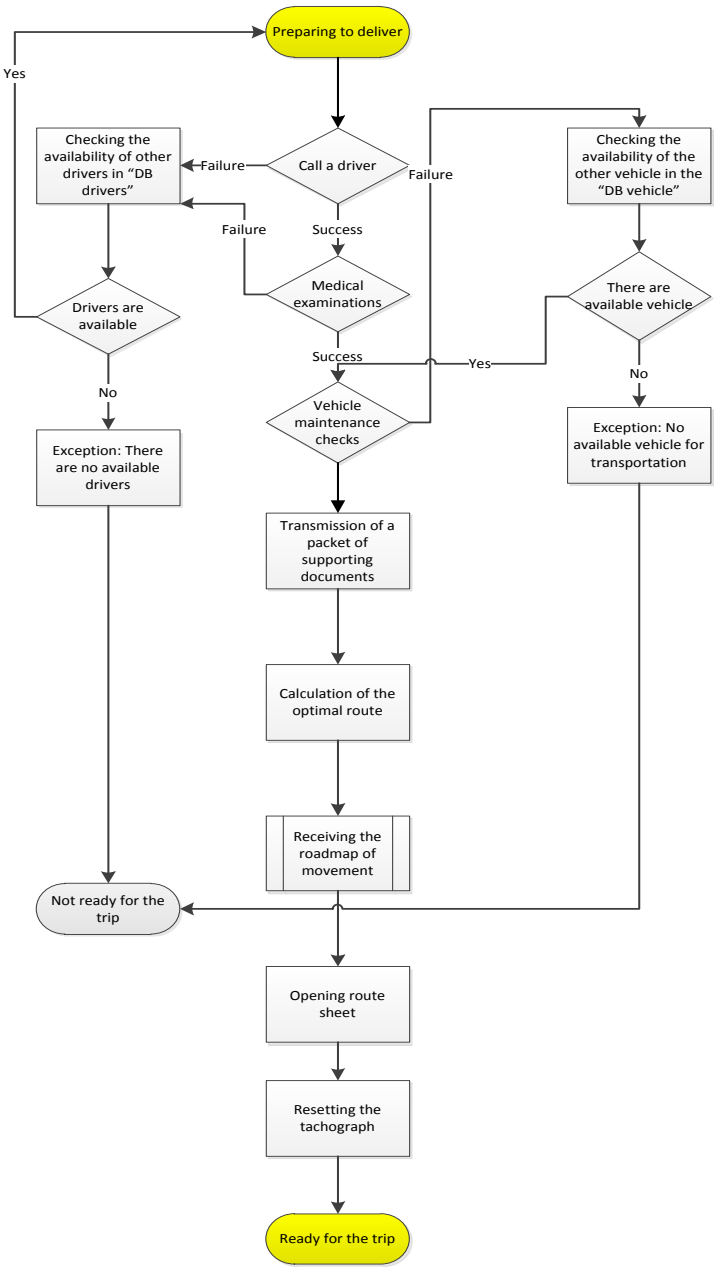
If you have this type of cargo and have the opportunity to make a route from origin to destination, we will use it. At this step verifies the ability to place the cargo in maritime transport. If it possible, we will use this type of transportation.

It is important to consider cost of transportation and choose the least expensive type of transport, of course if it possible. Aviation is traditionally one of the most expensive, so it is used mainly when it especially needed to customer, or when other type of transportation is unavailable.

Liquid cargo - cargo carried in the liquid state (petroleum and petroleum products, chemicals in liquid form, liquefied gases, food liquid cargo). During transportation, storage and handling of bulk cargoes is necessary to consider their specific properties: viscosity, flammability, volatility, explosiveness, vapor pressure, the effect on the human body, the corrosive action on metals, etc. Liquid cargo transported through pipelines in special tankers and rail tank in tank containers.

Bulk cargo - cargo that do not have special packaging or containers characterized by the one physical property, which is called flowability, the main types are: vasospasm; chemically hazardous; displaces; having clutch, without clutch materials, such as grain, coal, sand, coke, ores and ore concentrates, salt, bulk construction materials. Most often for the delivery of such type of cargo use trucks, whole ships or individual holds and enlarged cargo units: containers, trailers, fleets, roll-trailers, bags and so on. Enlargement of cargos allow to mechanize the process of cargo handling and increase the expediency of the merchant fleet.

Reefer cargoes - cargoes which require the creation of specific temperature and humidity conditions (non-perishable and perishable, which in turn are divided into: frozen, chilled, do not require strict temperature regime requiring ventilation, such as frozen meat, fish, fresh vegetables, fruits, flowers, etc.). Without compliance with these rules cargo transportation is impossible or possible only for a limited time. Refrigerator freights it is transported by vessels refrigerators (the most economic type of transport), on the territory of the Russian Federation railway refsektion and in cars thermoses.



Pic. 3. Preparation for cargo shipment

Dangerous cargos - cargoes which need special precautions, they include substances and materials with physic-chemical properties of a high degree of risk. Dangerous cargoes are divided into the following classes: explosives, gases, compressed, liquefied, flammable liquids, flammable substances and materials, oxidizing substances and organic peroxides, poisonous (toxic) substances, radioactive materials, and infectious substances, caustic and corrosive substances, other dangerous substance.

Dangerous cargos are carried by all modes of transport in conventional transport units, but they must be equipped with a certain way, the vehicle and the driver must have permission to transport dangerous cargos. The vehicle (the truck, the container, the tank container, the wagon) is designated by special stickers of safety, according to a class of danger of freight. It

is important that activity on acceptance and handling of dangerous goods at the terminals to be licensed.

Thus, taking into account the above mentioned factors, it should be noted that it is important to organize right work with requests that there was no queue, and had the opportunity to raise the priority of individual requests. For this purpose is represented the algorithm of the queue with priority which shown in pic. 2.

One of the stages of the system, a step of preparing the vehicle for the delivery of cargo which shown in pic. 3. It immediately follows after the step of loading the vehicle. Unfortunately, it's impossible to foresee a situation where the driver or the vehicle is not ready for delivery. This would simplify the system as a whole, however, in the case of this situation, the system tries to automatically resolve this problem and if not possible to solve this problem it will require operator intervention.

It is important to have feedback with the crew to be aware of what is happening. For this perfectly will approach complex tracking based on GPS with GPRS data transfer to the server. Thus it becomes possible to observe the significant parameters of the vehicle in real time. While delivery is working algorithm of emergency situations which helps quick decisions to get out of the current emergency situation. After a successful delivery the cargo at the base of the transportation company the next stage is the stage of unloading cargoes, machine forwarded to the base, where the next stage: closing waybill; handing over documents of delivered cargoes; renting cargo documents, the delivery of which failed; production vehicle in the queue for inspection; handing over of keys on the vehicle; handing over documents on the vehicle.

In database requests made appropriate records of what the cargoes were delivered, which are not. Completed requests are transferred to a separate database "Archive Requests", which will be stored some time before will be deleted, it will allow to view the details of execution of an order, and also get details of the person which sent and received an order.

This article presents only a part of algorithms that will be used in future automated system of cargo transportation. This system can greatly simplify the operation of the transport company as a whole and accelerate the turnover of the organization of cargo which in turn will bring a positive economic effect in the form of increase business profits. Another advantage of using this system should be more informative and greater control over the business as a whole, and will be able to view the subtotals outcomes and results of important economic indicators even those which would require significant computational costs and are not suitable without a computer.

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UTILIZATION TECHNOLOGY OF OIL - CONTAINING WASTES AS A DIRECTION OF RATIONAL NATURE MANAGEMENT

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The article describes the technology of utilization of sulphur-containing wastes of oil-processing productions, shows the main properties of sulphur materials using various modifying additives.

Keywords: wastes of oil-processing industry, sulphur materials, utilization of wastes, rational nature management.

One of the main elements of sustainable development of the country is the rational and efficient use of natural resources. Wastes represent a considerable loss of material and energy resources. Untimely processing and neutralization of wastes can be the reason of the environmental pollution and the impact of harmful substances and infectious organisms on people. The volume of wastes in the Russian Federation is presented in Table 1.

Table1-Volume of Wastes in the Russian Federation

The volume of wastes , tons	**2007**	**2010**	**2011**	**2012**
Total volume of wastes production, among them:	3899,3	3734,7	4303,3	5007,9
Agriculture, Fishing, Forestry	26,6	24,1	27,5	26,2
Mining	2785,2	3334,6	3818,7	4629,3
Manufacture	243,9	280,1	280,2	291,0
Construction	62,8	11,1	14,1	14,6
Production and distribution of electricity, gas and water	70,8	68	58	28,4
Others		16,9	104,7	18,3

As seen from Table 1 the total amount of wastes (especially in mining, as well as various manufacturing industries) increases annually. Thus, the produced wastes correspond to different classes of danger. The volume of dangerous wastes production in the Russian Federation is presented in table 2.

Table 2-The Volume of Dangerous Wastes Produced in the Russian Federation

	2007	**2010**	**2011**	**2012**
The volume of dangerous wastes (I-IV class of danger)	117,281	114,368	120,162	113,665
danger class I	0,1813	0,167	0,143	0,051
danger class II	1,3114	0,71	0,655	0,459
danger class III	11,051	16,671	15,79	11,643
danger class IV	275,1091	96,82	103,574	101,512

Enterprises of oil processing industry are often a source of wastes of increased danger classes. So, according to the Federal Classification Catalogue of Wastes - FWCC (Approved by the Order of the MNR of Russia dated 02.12.2002 N 786 (as amended by the Order of the MNR of RF dated 30.07.2003 N 663)) wastes of petrochemistry and oil refining such as sludge petroseparating installations, sludge from cleaning of tanks of oil tankers, grinding sludge oil-based, oily scale (the oil content is 15 % and more) refer to the third class of danger, wastes of acid resins (wastes of sour pitches), acid tar refer to the second danger class. The volume of wastes utilization and neutralization in the Russian Federation is presented in table 3.

Table 3 – The Volume of Wastes Utilization and Neutralization in the Russian Federation

The volume of wastes utilization and neutralization in the Russian Federation	**2007**	**2010**	**2011**	**2012**
Total volume of wastes utilization	2257,4	1738,1	1990,7	2348,1

and neutralization, among them				
Agriculture, Forestry, Fishing	19,2	19,8	23,4	23,2
Mining	1829,4	1562,2	1800,1	2125,9
Manufacture	85,4	124,4	124,3	164,6
Construction	38,8	10,1	11,3	10,3
Production and distribution of electricity, gas and water	8,3	9,8	13,3	9,2
Others		11,8		14,9

From table 3 one can make a conclusion that mining and manufacturing (including oil) production are the main «consumers» in terms of using wastes produced. An important component of the system of rational use of resources is the recycling and reuse of wastes. The level of economic efficiency grows in the country, but the area of land that can be used for placement and removal of wastes is reduced. The increase of processing and recycling of wastes leads to reduction of the environmental impact on the environment. [1]

Technology of wastes recycling is considered to be the best one for ensuring the environmental safety. When choosing a technology one should take into account its reasonability and feasibility for consumers. For a particular sector of industry the necessary technology can be implemented taking into consideration both economically and technically available conditions. An important aspect of wastes utilization at petrochemical plants (oil industry) is to protect the environment, i.e. the use of the technology of wastes utilization and neutralization should not mean even further and greater pollution. The priority direction in wastes management is their usage as secondary material resources. This allows not only to reduce the load of environment, but also to ensure more rational use of natural resources. The basic principles for the choice of the necessary technologies of wastes utilization and neutralization in petrochemical enterprises are as follows:

- determination of their composition, quantity and properties as well as factors affecting their changes;
- use of technologies causing minimal environmental damage, having low capital costs, and allowing to get profits;
- selection of the scope of wastes as secondary material resources depending on the composition of wastes, operational, technological and sanitary-hygienic requirements to raw materials and manufactured products. [7].

Ecological principles modernization of wastes utilization involves not only the interaction between traditional methods of wastes management and measures for reducing their quality, recycling and neutralization, but also control, environmental safety assessment of wastes and recycling products.

In this connection some ways of using elemental sulphur – a large-tonnage waste of oil refining are developed. The concept includes two directions: the first - the transformation of conventional crystalline cyclooctasulfur in specific variations - amorphous, water-soluble, organo-modified, alloyed and others; the second - obtaining the compounds with a high sulphur content (organic and inorganic polysulphides, sulfur-containing polymers (thiokols), sulphurated organic products). The following perspective areas of applications of sulphur and sulpher-based compositions are found: gidrofobizator and binding items in construction industry, fungicides and acaricides in agriculture and forestry, anti-seize and antiwear additives

to oils, the sealants modifying additives to polymeric compositions, emulsifiers, etc. The method of application including polymerization technology of sulphur and manufacture of its electrodes for lithium-sulphur batteries (Li-S) has already been known. This new generation of elements of power is better adapted for electric cars, hybrid vehicles and military use as being cheaper, lighter and more efficient than lithium-ion batteries being used now.

The world market of sulphur in recent years and even up to 2015-2020 will have a strong tendency of excess of sulphur production on its sales. This is due to a deep clearing of sulphur from associated gases, oil products, development of sulphur-containing gas and oil fields etc. For this reason, today in connection with the fall of sulphur prices on the world market it becomes more profitable to use it in the construction and road construction industries.

The application of this technology will solve the problem of radical improvement of technologies of construction and quality of coating roads, increase operating reliability while reducing their costs, provide chemical and other industries with available corrosion-resistant structural materials, involve in the manufacture of large-capacity wastes at oil refining enterprises and improve the ecological situation at the enterprises, solve important social-economic problems of improving transport provision of the population and enterprises [4].

In many countries such as: the USA, Canada, France, Germany, Denmark, Poland, Japan, Kuwait the intensive investigation and development of new areas of application of sulphur are carried out.

Specific properties of sulphur compositions including the low level of natural radioactive background, the protective properties of electromagnetic and radioactive emission find the application of sulphur in road and construction industries. Various modifying additives for regulating the properties of sulphuric materials are applied. The use of modifying additives is one of the most rational methods of management of technology of manufacturing sulphur building materials and regulation of their properties [3]. Different organic and inorganic compounds as modifying additives are used (table 4).

Table 4 - Basic Multicomponent Chemical Additives Introduced Into Sulphur Materials [4–6]

№ p/p	Additives	Additives Concentration % Depending on Sulphur Mass	Additives Effect
1.	Bitumen	0,5...150	Has plasticizing effect and increases water resistance
2.	Gasoil	5...10	Plasticizer
3.	Tar	до 50	Increases frost resistance
4.	Rosin	1,3...5	Plasticizer
5.	Lignin ammoniated	80...300	Plasticizer
6.	Petroleum fractions distilled at T=250...400°C	25 ... 66	Raise the frost resistance and have a plasticizing effect
7.	Linseed	5...10	Plasticizer
8.	Paraffin	–	Plasticizer
9.	Rubber crumb	3...9	Has plasticizing effect and increases the toughness
10.	Mixture of antimony oxide and triphenyl phosphate chlorinated	1…20	Increases fire resistance
11.	Crude oil	0,1...50	Increases frost resistance
12.	Turpentine	0,5...0,7	Plasticizer

13.	Resin coal	25...66	Plasticizer
14.	Tsellofot	5...210	Plasticizer
15.	Ceresin	10...19,75	Increases alkali resistance and has a plasticizing effect

Depending on functional purposes of modifying additives they are divided into plasticizers, stabilizing, gas and air additives, as well as additives improving fire - and bios-resistance of sulphur materials, etc. [5]. Naphthalene, paraffin, dicyclopentadiene, thiocol, rubber crumb and others are often used as plasticizing additives. According to some researchers [5 -7] these additives, except plastification of concrete mix, help to remove air, increase strength, reduce fragility and prevent the crystallization of sulphur while cooling. Various gazo- and airinvolving additives representing low-boiling substances of an organic origin, for example, fluorinated and chlorinated hydrocarbons, are introduced for receiving heat-insulating sulphur materials [5]. Besides, for this purpose they use also inorganic substances, for example, carbonates in combination with inorganic acids. The introduction of these additives can significantly reduce the average density of manufactured materials. One of the disadvantages of sulphur materials is their low fire resistance. Reduced sulphur concrete combustibility is reached by the introduction of fire-retarding agents: geksabrombutena, five-chloride phosphorus, pentachloride and others in its composition [3, 5]. Sulphur materials have high resistance to different biological aggressive environments. However there is a group of microorganisms (bacteria) which destroys sulphur materials. Antiseptics for increasing the biological resistance are introduced. The most common additives of this class are: thymol, naphthalene, tetrabromine-p-cresol and others [5, 6]. Besides, the majority of used fire-retarding agents and antiseptic tanks provide plasticity increase of sulphur-concrete mixes and improvement of physicomechanical properties of sulphuric materials. As seen from table 4 the majority of modifiers of sulphur are contained in various wastes of oil processing. Moreover, sulphur itself belongs to wastes. The morphological relationship of the chosen wastes and their compatibility allow to consider receiving effective environmentally organic composites with a number of valuable operational properties as perspective technology of utilization of oil-containing wastes.

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CLASSIFICATION OF DECISION-MAKING SUPPORT SYSTEMS FOR MAIN PIPELINE MONITORING TASKS

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This publication is dedicated to the problem of pipeline monitoring and diagnostics during raw hydrocarbon transportation. It reviews the existing decision-making support system classifications.

Keywords: decision-making support systems, main pipelines

The fuel and power industry (FPI) is one of the major sectors in many economies directly affecting their budgets. The FPI includes sectors producing and processing various fuels (fuel industry), electric power industry, and electric power transportation and distribution facilities. The significance of the gas industry is primarily based on the fact that natural gas holds the third place after oil and coal and accounts for about 20% of global fuel and power consumption. It is also important that natural gas is the ecologically cleanest energy resource among these three primary ones. Hydrocarbon and hydrocarbon by-product production, processing, transportation, warehousing and sale underlie this industry.

The development of gas transportation systems is a major factor affecting the potential of increasing and expanding the production and consumption of gaseous fuel. Natural-gas is transported within a gas field and delivered to the end consumer using pipelines, and transferred over significant distances using main pipelines or, in liquid form, special tankers. Although their construction and service is rather expensive, they are currently the cheapest and most convenient oil product transportation method. Given that a significant part of pipelines has been built in the past century, they are becoming outdated now. Ageing-related factors cause ruptures and leaks resulting in significant economic losses.

One of the solutions to this problem is using decision-making support systems (DMSS) to monitor main pipeline facilities and to timely make decisions regarding leak elimination. DMSS are widely used by the largest oil and gas enterprises now, but there is no efficient solution in the field of monitoring and diagnosing.

The existing classifications of such systems have to examined to design an efficient decision-making support system.

A decision-making support system is an automated computer system helping decision-makers to exhaustively and objectively analyze the subject activity in difficult conditions.

There exists no generally adopted exhaustive classification of decision-making support systems, but decision-making support systems can be divided in several levels.

User-level systems can be divided in:

- Passive ones;
- Active ones;
- Cooperative ones.

Passive decision-making support systems assist the decision-making process, but cannot propose a decision.

Active systems can propose a decision.

Cooperative systems enable decision-makers to change, supplement or improve the decisions proposed by the system, and then send these changes to the system for checking. The system changes, supplements or improves these decisions, and resends them to the user. The process continues until a coordinated decision is obtained.

Conceptual-level decision-making support systems are classified as:

- Message-operated ones;
- Data-operated ones;
- Document-operated ones;
- Knowledge-operated ones;
- Model-operated ones.

Model-operated systems are based on mathematical models. OLAP systems enabling a complicated data analysis can be used to build them, and then such decision-making support system can be classified as a hybrid system enabling data simulation, search and processing [1].

Message-operated systems support a group of users working on a common task.

Data-operated systems are access and manipulate data.

Document-operated systems search for and manipulate unstructured information specified in various formats.

Knowledge-operated systems provide task solutions in the form of facts, rules and procedures.

Decision-making support systems are divided in the following ones by the data they handle:

- Tactical ones;
- Strategic ones.

Tactical decision-making support systems are intended to immediately respond to changes in the current situation during management of financial and economic processes in the company.

Strategic systems analyze considerable amounts of various information gathered from various sources.

Decision-making support systems are divided in the following ones by the task:

- Class 1 systems;
- Class 2 systems;
- Class 3 systems.

Class 1 decision-making support systems possessing the largest functionality are intended for use by top level state agencies (Presidential Administration, ministries) and large company management bodies (board of directors) in planning large integrated targeted programs to substantiate decisions concerning the inclusion of various political, social or economic measures in the program and distribution of resources between them on the basis of evaluation of their effect on reaching the main goal of the program. Decision-making support systems of this class are shared systems with knowledge bases generated by many experts specializing in various fields of knowledge.

Class 2 decision-making support systems are individual systems with user-generated knowledge bases. They are intended for use by middle-level public officials as well as managers of small and mid-size firms to solve current management problems.

Class 3 decision-making support systems are individual systems adapting to user's experience. They are intended to solve frequent applied system analysis and management problems (for example, selecting the subject of crediting, contractor, appointment to a position, etc.). Such systems provide solutions to current tasks on the basis of information about results of practical use of decisions of previous solutions of the same task. In addition, systems of this class are intended for use by trade enterprises trading in expensive durable goods as a means of 'intelligent advertising' enabling the buyer to select goods on the basis of his/her experience of using goods designed for similar purposes [1,4].

At the technological level, decision-making support system are divided in:

- Enterprise-level systems;
- Desktop systems.

Enterprise-level systems are connected to large information storages and service several enterprise users. Desktop systems are typically not large and are designed to service one user.

Decision-making support system are divided in the following types by the method used:

- Genetic algorithm;
- Simulation;
- Cognitive simulation;
- Precedents-based reasoning;
- Neural networks.

The genetic algorithm operates a set of representatives which can be considered as possible solutions to the task set. The best representatives selected at each step mix up with each other to produce 'mutants'. Even better results are expected from the new representatives obtained this way. The process repeats several times until the target value is reached [2].

The simulation-based approach to building a DMSS is based on a multi-stage decision-making procedure including the following stages:

1)Identify structural features of the data received during monitoring using the concept of data storage and trend analysis

2)Visualize the dependences identified in the data using means of intelligent data analysis and OLAP technologies

The cognitive model presents information about the system in the form of a set of concepts and interconnecting causal network ('cognitive map') reflecting expert's subjective ideas of the laws inherent in the simulated system [3].

The main goal of using precedents in the DMSS is to deliver a ready solution for the current situation to the decision-maker on the basis of precedents that already took place in the past during management of this object or process.

Neural networks are attractive from the intuitive point of view, as they are based on a primitive biological model of nervous systems and enable reproducing complicated dependences.

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AUTOMATED ABSTRACTION METHODICS APPLIED TO INTERNET NEWS TEXTS

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This article is devoted to a problem of an automated abstracting – drawing up reviews in texts of Internet news. Construction and structure of the news text, stages of its analysis, principles and methods of drawing up of author's abstracts under news articles are considered.

Keywords: automated abstracting, Internet news texts, methods of abstracting.

Million news texts pages appear online every day. For example, only the number of daily posts in Twitter closes to the mark of 400 million records per day or almost 4.5 thousand messages per second. The processing of information material by hand requires a huge human resources, labor and time consuming. Therefore there was a problem of creating methodics for automated abstracting articles. Corporate document management systems, search engines and directories of Internet resources, automated library information systems, broadcasting channels, news feeds and many other systems feel needs in means of automatic summarization and annotation [5].

This area of research is highly valued In Russia, as well as abroad [1, 2, 5, 6]. A large number of automatic text summarization systems is known nowadays. It is TextAnalyst, Content Analyzer, AOT, RCO, Microsoft Word, Yandex News system among Russian and Extractor, QDA Miner, Inxight Summarizer (component of search engine AltaVista), Intelligent Text Miner (IBM) among foreign [2, 5]. However, the most of the leading systems developed at the West and they are focused only on the processing of Western Europe languages. It makes them unsuitable for the analysis of Russian texts.

In addition, only few systems are directly focused on the summarization of news texts. As a rule, these are the components of search engines of the various systems (Yandex News, Inxight Summarizer, Newblaster). But their task is an automatic annotation of news clusters (groups of texts with similar subject) rather than summarization of individual texts selected by the user [3].

It is necessary to represent articles in a compressed format but with the preservation of their meaning to facilitate the study of existing and creation of new online texts. Therefore, it is necessary to combine several algorithms for summarization to achieve the optimal result. Further we consider the specifics of news articles, their structure and automated abstracted methodics.

Having reviewed a number of articles submitted at the well-known news sites such as Lenta.ru, NewsRu.com, Kommersant.ru, Expert (and others related to the top 30 news portals of Ru.net), we can build a common structure of the news text (figure 1).

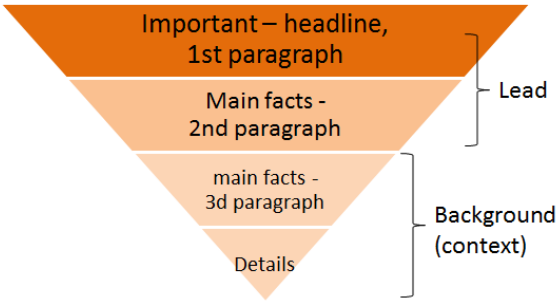

Figure 1. Structure of the news text

This structure is based on the principle of "inverted pyramid", which requires placement of basic information at the beginning of the material and its subsequent detailed disclosure.

- Headline of the news reflects its topic and contains no more than 10 words (80 characters). So, for example, not more than 15 words in the title displayed in Yandex, Google displays up to 70 words.

- Basic facts about the events reflected in paragraphs 1-2, and constitute the so-called lead of text (covers the main theme).

- 3rd and subsequent paragraphs make a background of news (context). As a rule, details of happening are disclosed there, the information directly related to the news is given.

Therefore, if we will know the characteristics of online texts structure than we can highlight the key facts of the news article, define the object and the subject of news and draw up a logical abstract. Automated abstraction methodics applied to Internet news texts will be considered further at this work.

Today there are many ways of solving the problem of text summarization. We will use the traditional approach of auto-abstracting proposed by H. Luhn, with some modifications for the processing of news texts.

Solution of the problem of news text summarization can be divided into several stages (figure 2).

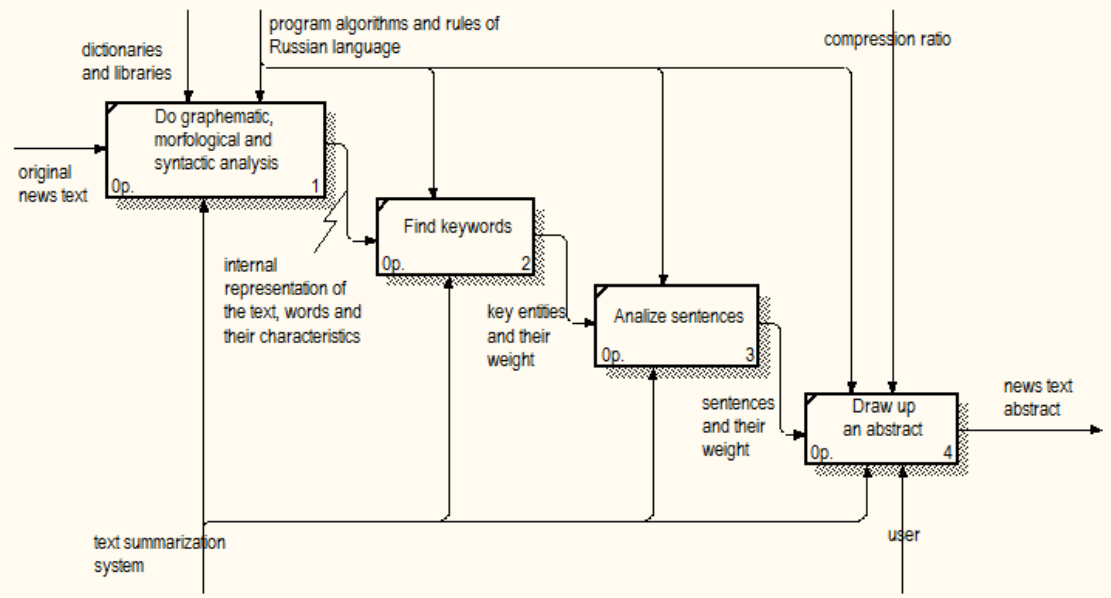

Figure 2. The procedure of text summarization

The information necessary for further processing by morphological and syntactic analyzers produced at the initial stage of text processing – graphematic analysis [3]. This stage includes internal representation of the news text structure as a triplet T = <P, S, W>, where P - paragraphs, S - sentences, W - words. Correct identification of the title and of the first sentence in the paragraph that contains the basic facts of the article is also necessary at this stage.

The next step is the morphological analysis. It has a purpose to construct the morphological interpretations of words from input text. All methods can be divided into two groups - the vocabulary and probability-statistics (without using a dictionary). The disadvantages of the first are the large amount of lexicons, poor performance on a small sample, the lack of precise linguistic methods. The second method (vocabulary) is based on the connection of dictionary or thesaurus and it gives the most comprehensive analysis of the word's form.

Some morphological library should be used for this step, for example, MCR.dll library. Morphological analysis here is based on the Zaliznyak dictionary. This dictionary contains about 100 thousand words of common language lexicon. A lot of morphological interpretations such as the morphological part of speech, lemma (for example, the nominative singular noun or infinitive verb), a plurality of grammemes sets - elementary descriptors that identify word form to any morphological class (gender, number, case) is given for each word from the input text [5]. We can use the Porter's stemmer in order to work with unfamiliar words.

The algorithm of morphological analysis is shown at figure 3.

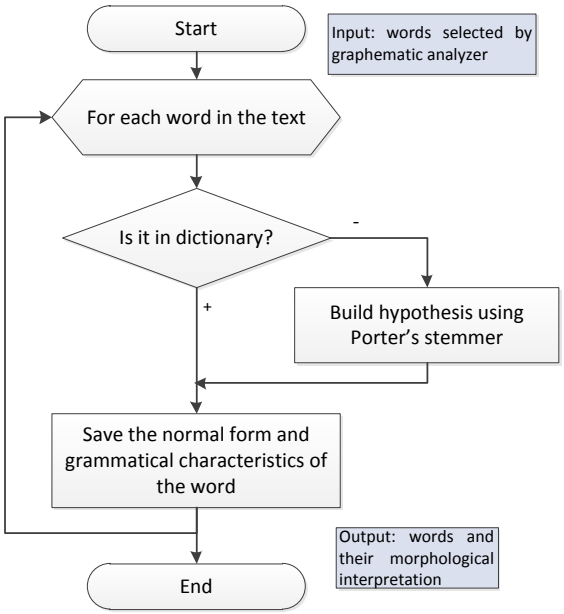

Figure 3. Algorithm of morphological analysis

Syntactic analysis is considered as a problem of constructing a sentence dependency tree. The task of creating such analyzer is quite time-consuming, so we are developing the simplified syntactic analyzer to split complex sentences into simple.

There are a big number of keywords extraction methods now. The most famous of them are TF-IDF and C-Value.

TF-IDF, term frequency–inverse document frequency, is a numerical statistic which reflects how important a word is to a document in a collection or corpus. TF is the number of times that term t occurs in document d, IDF is a measure of whether the term is common or rare across all documents. It is obtained by dividing the total number of documents by the number of documents containing the term, and then taking the logarithm of that quotient.

$$IDF = \log \frac{|D|}{|(d_i \supset t_i)|} \quad (1)$$

where |D| - the total number of documents in the corpus; $|(d_i \supset t_i)|$ - number of documents where the term t_i appears (when $n_i \neq 0$).

TF-IDF is the product of two statistics, term frequency and inverse document frequency.

The C-value is given as follows:

$$C-Value(a) - \begin{cases} \log_2 |a| \cdot freq(a), \text{ a is not nested} \\ \log_2 |a| \cdot freq(a) - \frac{1}{P(T_a)} \cdot \sum_{b \in T_a} freq(b) \text{ otherwise} \end{cases} \quad (2)$$

where a – is the candidate string, |a| - is the number of words in string a, freq(a) – is the frequency of occurrence of a in the corpus, Ta – is the set of extracted candidate terms that contain a, P(Ta) – is the number of these longer candidate terms [6].

However, software modules for keywords and entities extraction have already existed. These modules include PullEnti, written entirely in C #. NET. We have developed the keywords extraction algorithm for our program. It's combining the extraction of named entities from news text (based on the results of morphological analysis and the plug-PullEnti work results) and counting the weight of words considering the frequency of its occurrence (figure 4).

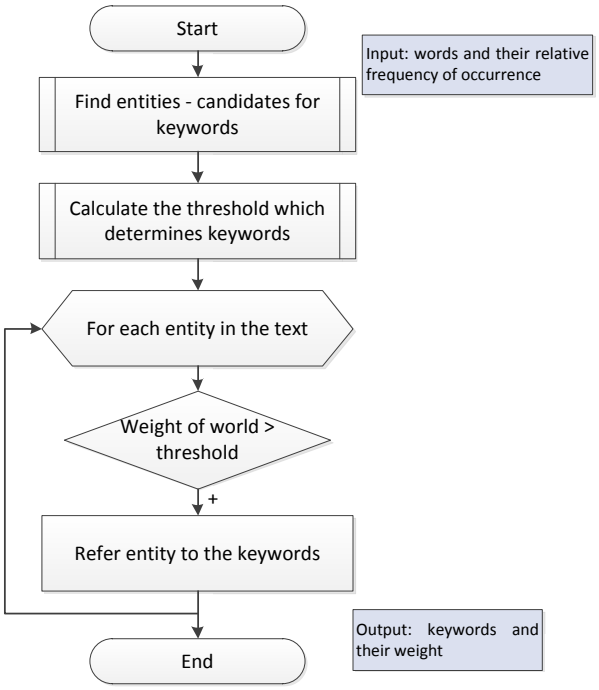

Figure 4. Keyphrases extraction algorithm

The relative frequency of a word-candidate for keywords with the index equal (0,2 × number of entities) is a threshold for the recognition word as a keyword.

The identify of characteristic fragments is necessary for preparation of extracts. LexRank algorithm modification and Manifold-Ranking algorithm are the most well-known methods using for fragments allocation [7].

We have developed our own methodics for key fragments extraction applied to news text. But it is necessary to perform the following processing of sentences before drawing up the news text review (figure 5).

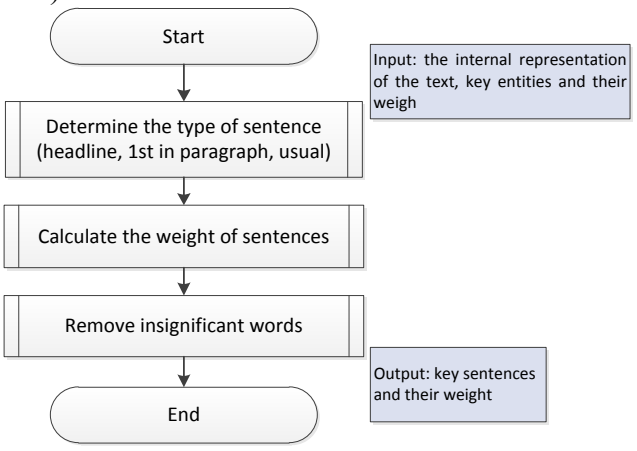

Figure 5. Sentences analysis algorithm

Calculation of sentences weight is based on its location in text. It is calculated as follows:

$$Ws = N(kw) \cdot Rf(kw) \cdot \text{Paragraph weight} \cdot k \quad (3)$$

Where ws – sentence weight; N (kw) - the number of keyword occurrences in the sentence; Rf (kw) - the relative frequency of the keyword, paragraph weight - the relative weight of the paragraph in the text, it is 0.35 for the first paragraph (lead), 0.2 for the second, 0.1 for others (context); k - coefficient of sentence significant within a paragraph. It is equal 1 for the first sentence of the paragraph, for others - 0.8.

The annotation includes the sentences with the greatest weight, and it's based on adjusted compression ratio.

Developing program will also include the integration with news sites, the possibility to reduce the text for twitter.

Let's consider the work of automated abstracting algorithm within the example of Internet news text under the headline "Doctors have found out what time of day a person feels happy":

«USA scientists have spent two years trying to find out - what time of day the person feels most happy? Scientists have analyzed Twitter messages. Total examined 600 million posts from 2.5 million users in more than 80 countries. The study found that users were more happy in the morning. By evening, the emotional mood of people gradually deteriorates.

In addition, it was found that most good mood of people there in the winter months from December to January, according to epidemiolog.ru .However, it is necessary to clarify: a happy period ends, most likely, not at the end of January but at 16th. This is the third Monday in January, which is considered the most depressing day of the year.

The conclusion was reached by a British psychologist Cliff Arnell from the University of Cardiff. He has consumed a complex formula that takes into account the ugly weather, the fact that the holidays have passed and we should get to work, we must somehow plan for the future. Not pleased with the fact that until the following holidays away.

The scientist allegedly received the date corresponding to the third Monday by dividing and multiplying specific coefficients reflecting the state of the human soul in the middle of January» [4].

We expect to obtain the following results of abstracting algorithm work.

Keywords: necessary, scientists, find out, mood, people, Twitter, time of day, feels, most happy, the third Monday.

Text review: «USA scientists have spent two years trying to find out - what time of day the person feels most happy? The study found that users were more happy in the morning. However, it is necessary to clarify: a happy period ends, most likely, not at the end of January but at 16th. This is the third Monday in January, which is considered the most depressing day of the year. The conclusion was reached by a British psychologist Cliff Arnell from the University of Cardiff. He has consumed a complex formula that takes into account the ugly weather, the fact that the holidays have passed and we should get to work, we must somehow plan for the future».

So we have developed an automated abstraction methodics applied to Internet news texts. Methodics is based on combination and modification of existing algorithms [8], [9] of drawing abstracts. In the current information age, with a huge number of Internet news reports, using of such technologies is necessary as it's make faster the processing of daily information.

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STRUCTURAL-DIFFERENTIAL SEGMENTATION OF IMAGES OF DOT OBJECTS ON THE DECREASING BACKGROUND

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The urgency structural differential descriptions of dot images on a decreasing background is proved. Specification of verbal criterion of a segment is carried out. The concept of insignificantdifferential area is entered. The structural de-scription of the dot image on a decreasing background is proved.

Keywords: image, raster, pixel, segmentation, binarization.

Segmentation of images — one of the main tasks of recognition of images. This division of images into some areas which differ from each other certain characteristic signs. Brightness, color, form can be such signs. The wrong allocation of segments on the image will be reflected in quality of recognition and can even make this recognition impossible.

In [1] the way of segmentation of images on the basis of the analysis of structure of differences between intensities of each element and next to it in eight directions is declared. [2] this way it is modified, structural definitions of various raster elements are considered, their classification and priority levels is offered. In works [3-18] this way is modernized, its practical applications for the solution of various specific objectives are offered, terminology and logical functionalities is specified. Various components of a way are used at the solution of other tasks of the analysis and control of distributions of various physical parameters. It found reflection in works [19-42].

In [3] it is offered to understand area of the connected insignificant differences as a segment of a raster surface, any of which elements has no negative difference if this area doesn't contain elements of edge of a raster surface.

Such definition of a segment needs specification. It isn't really clear that this represents "area of the connected insignificant differences" and its elements. If an element of area is the insignificant difference how it can have a negative difference?

Element of a segment is the pixel. We will enter concept of insignificant-differential area. We will understand area of the pixels connected between by insignificant differences if any of these pixels has no insignificant difference outside this area as such area. We will understand the insignificant-differential area as a segment, any of which elements has no negative difference. In the analysis the raster image can be interpreted as a surface in three-dimensional space. Each element of this surface has two coordinates of the corresponding element of the flat raster image, and the third coordinate is intensity (for example, brightness) this element. In such way, the segment is a vicinity of a local maximum, local top of a raster surface.

Search of local tops of a raster surface directly by this criterion is impossible at least because there will be a great variety of insignificant and differential areas on "slopes" of these "tops". Such insignificant-differential areas from the point of view of segmentation aren't of interest. The insignificant-differential area has to be either a segment, or a background.

In [3], [4] and [5] the principle of classification of the pixels, based on the analysis of structure of differences on couples of directions with assignment of levels of preferences (priority) is offered classes of couples of directions. Also logical functionality by which the automated system will determine is offered, is this fragment a segment or not.

$$H = (h_1 h_3 \cup h_2) h_4 \qquad (1),$$

where signs of h_1, …, h_4 — logical statements:

h_1: the fragment is area of the connected horizontally positive elements;

h_2: the fragment is area of the connected topmost elements;

h_3: the fragment isn't adjoined by any negative and planimetric element;

h_4: the fragment isn't adjoined by any regional element.

We will consider the structural description of an element of the raster image which all couples of directions are topmost (tab. 1).

Table 1

The structural description of an element of the raster image,
which all couples of directions are topmost

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	2	2	the topmost
3	2	2	the topmost
4	2	2	the topmost

Graphically this description is interpreted as follows (fig. 1).

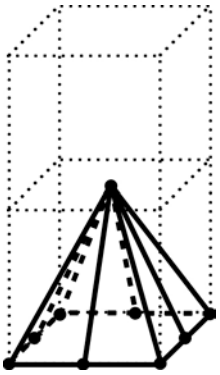

Fig. 1. Structural description of an element of the raster image, which all couples of directions are topmost

It is intuitively clear that this element of the raster image represents a single-element segment. It is a bright point on the image. The segment is understood as the insignificant-differential area, any of which elements has no one negative difference. The pixel is connected with itself an insignificant difference ($Z_{i,j}–Z_{i,j}=0$). Therefore if separately taken pixel has no insignificant differences, it is single-element insignificant-differential area. The pixel in fig. 1 has no negative differences. => pixel presented in fig. 1 has to be defined by the automated system of processing of images as a single-element segment.

Really, as all couples of element topmost, the element too will be defined as topmost. This element has no next topmost elements => the automated system will define this element as single-element area of the connected topmost elements ($h_2=1$) => this single-element fragment can't be defined in any way as area of the connected horizontally-positive elements ($h_1=0$). The fragment isn't adjoined by any negative and planimetric element ($h_3=1$). We will assume that the considered element isn't near the stage edge ($h_4=1$). In result the automated system will define logical functionality of H for this single-element fragment:

$$H = (h_1 h_3 \cup h_2) h_4 = (1 \cdot 1 \cup 1) \cdot 1 = 1.$$

Thus, the topmost element will correctly be defined as a single-element segment of the grayscale raster image.

We will look as structural definitions if to replace one of topmost couples of considered element with negative will change (tab. 2).

Table 2

Structural description of an element of the raster image, three which couples directions are topmost, and one — negative

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	2	2	the topmost
3	2	2	the topmost
4	1	1	the negative

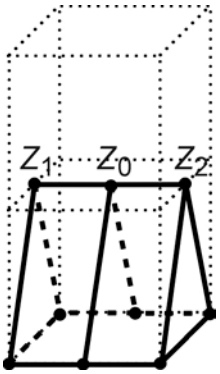

Fig. 2. Structural description of an element of the raster image, three which couples directions are topmost, and one — negative.

The Z_0 element definitely is an element of insignificant-differential area. Within fig. 2 it is connected by insignificant differences with the Z_1 and Z_2 elements. These elements also are elements of insignificant-differential area, and the same, as the Z_0 element. This area can proceed outside fig. 2. Now we will try to answer a question, whether is the Z_0 element a segment element. We can't answer this question because we don't know that occurs outside fig. 2. Elements can have negative differences outside fig. 2. The Z_1 and Z_2 elements can be connected by insignificant differences with other elements, and any of these elements can have a negative difference. In this case the Z_0 element isn't a segment element. If it not so, and the Z_0 element isn't connected by insignificant differences with one of the elements having negative differences, the element should be carried to segment elements.

We will analyse structural determination of pixel Z_0 formed by system of automatic processing of images. This pixel has one negative couple of directions and two topmost. The negative couple has higher level of a priority [5], than topmost => the pixel of Z_0 will be defined as negative => this pixel will be defined as a horizontally-positive element and carried to area of the connected horizontally-positive elements (h_1=1). Element of area of the connected topmost elements the negative pixel can't be by definition => h_2=0. We will consider that the area of the connected horizontally-positive elements which possesses the Z_0 element, doesn't adjoin the stage edge (h_4=1). Value of a sign of h_3 depends on the provision of area of the connected horizontally-positive elements outside fig. 2. Let the Z_0 element belong to the insignificant-differential area, any of which elements doesn't contain any negative difference. In this case on area borders all elements will have insignificant differences in area and positive differences out of its (fig. 3).

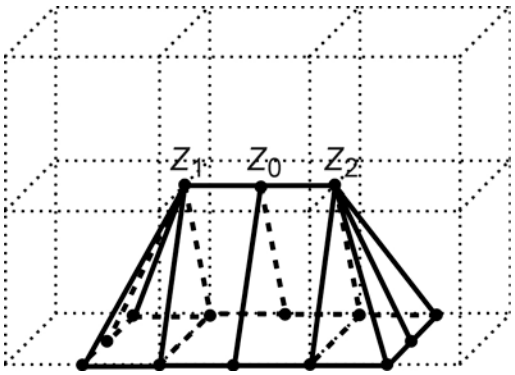

Fig. 3. Insignificant-differential area without negative differences.

It is intuitively clear that this area is a vicinity of a local maximum of a raster surface, that is, in our understanding, its segment. The criterion formulated by us also speaks about it.

We will analyse, what structural definitions will be made by system of automatic processing of images according to algorithm developed by us.

As it was already shown, the Z_0 element will be defined as negative. We will make structural descriptions of the Z_1 and Z_2 elements in a tabular form (tab. 3, 4).

Table 3

Structural description of the Z_1 element

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	2	2	the topmost
3	2	2	the topmost
4	2	1	the positive-planimetric

Table 4

Structural description of the Z_2 element

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	2	2	the topmost
3	2	2	the topmost
4	1	2	the positive-planimetric

As we see, these elements contain on one positive-planimetric couple of directions, the others — topmost. The positive-planimetric couple has higher level of a priority [5], than topmost, => both of these elements will be defined as positive-planimetric. Classes of negative and positive-planimetric elements are united in one class: horizontally-positive elements. Thus, the Z_0, Z_1 and Z_2 elements (fig. 3) form area of the connected horizontally-positive elements (h_1=1).

We will assume now that this area represents an accurate vicinity of a local maximum, that is outside fig. 3 intensity continues to decrease. We will make the graphic structural description of area of the connected horizontally-positive elements with elements (fig. 4) adjoining it.

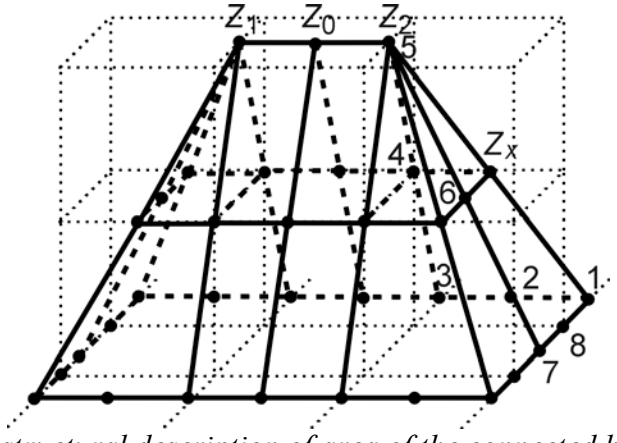

Fig. 4. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 1.

We will designate the element located to the right and up on a diagonals from area through Z_x. We will analyse as its differences will be defined and to what class it as a result will be carried. We will make the structural description of the Z_x element in a tabular form (tab. 5).

Table 5

Structural description of the Z_x element No. 1

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	1	the positive-planimetric
2	2	0	the positive
3	2	1	the positive-planimetric
4	1	2	the positive-planimetric

As we see, this element has one positive couple of directions (second), the others — positive-planimetric. The positive couple of directions has higher level of a priority, than positive-planimetric [5] => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 5).

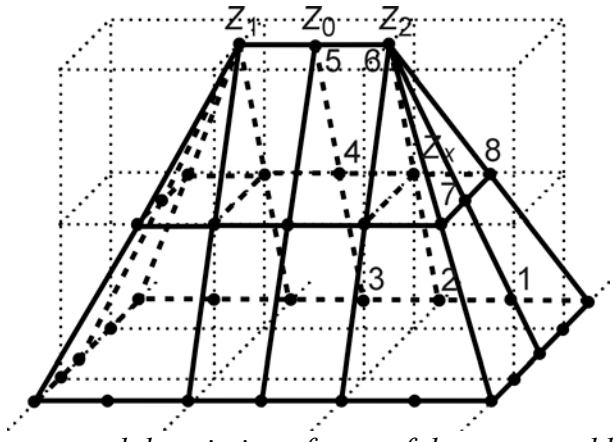

Fig. 5. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 2.

As we see, the Z_x element, as well as all elements of a contour of drawing, adjoins area of the connected horizontally-positive elements.

We will make the structural description of the Z_x element in a tabular form (tab. 6).

Table 6

Structural description of the Z_x element No. 2

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	0	the positive
2	2	0	the positive
3	2	1	the positive-planimetric
4	1	1	the negative

As we see, this element has two positive, one negative and one positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 6).

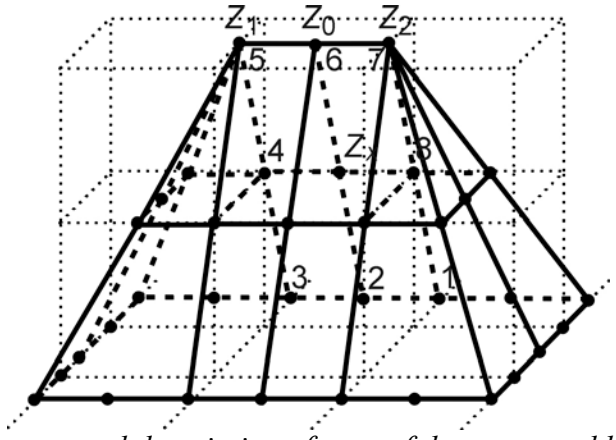

Fig. 6. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 3.

We will make the structural description of the Z_x element in a tabular form (tab. 7).

Table 7
Structural description of the Z_x element No. 3

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	0	the positive
2	2	0	the positive
3	2	0	the positive
4	1	1	the negative

As we see, this element has three positive and one negative couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

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STRUCTURAL-DIFFERENTIAL SEGMENTATION OF IMAGES OF SHAPED OBJECTS ON THE DECREASING BACKGROUND

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The structural description of a negative element with three topmost pairs of directions is proved. Modeling structural definitions for elements of the shaped image on a decreasing background and for elements, to it adjoining is carried out.

Keywords: image, raster, pixel, segmentation, binarization.

The method of structural and differential segmentation of grayscale images is stated in publications [1-18]. Appendices of this method in adjacent areas found reflection in publications [19-38].

We will advance the Z_x element on a drawing contour counterclockwise (fig. 1).

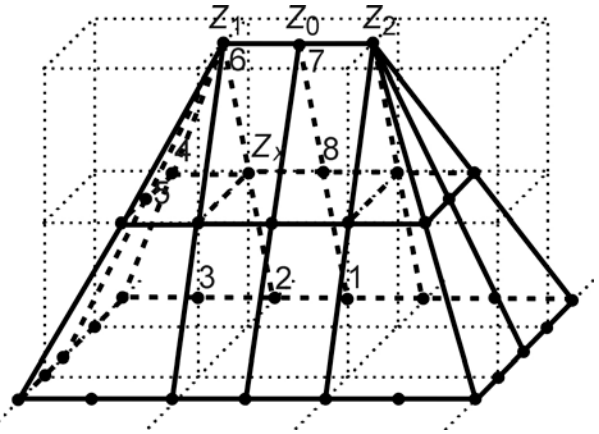

Fig. 1. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 4.

We will make the structural description of the Z_x element in a tabular form (tab. 1).

Table 1
Structural description of the Z_x element No. 4

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	1	the positive-planimetric
2	2	0	the positive
3	2	0	the positive
4	1	1	the negative

As we see, this element has two positive, one negative and one positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 2).

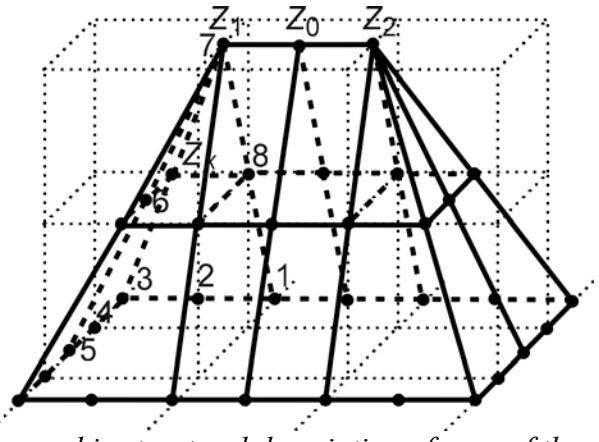

Fig. 2. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 5.

We will make the structural description of the Z_x element in a tabular form (tab. 2).

Table 2
Structural description of the *Zx* element No. 5

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	2	1	the positive-planimetric
3	2	0	the positive
4	2	1	the positive-planimetric

As we see, this element has one positive, one topmost and two positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 3).

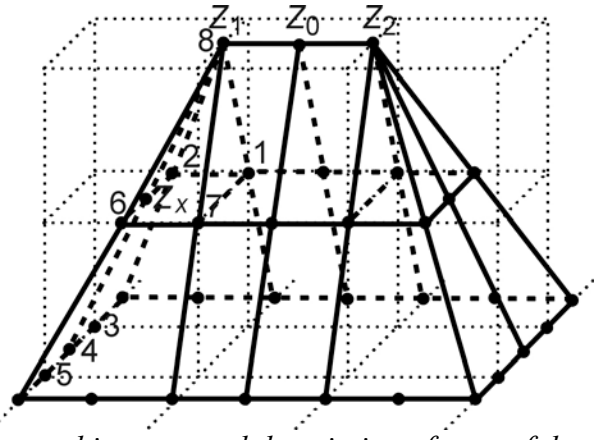

Fig. 3. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 6

We will make the structural description of the Z_x element in a tabular form (tab. 3).

Table 3
Structural description of the Z_x element No. 6

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	1	2	the positive-planimetric
2	1	1	the negative
3	2	1	the positive-planimetric
4	2	0	the positive

As we see, this element has one positive, one negative and two positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 4).

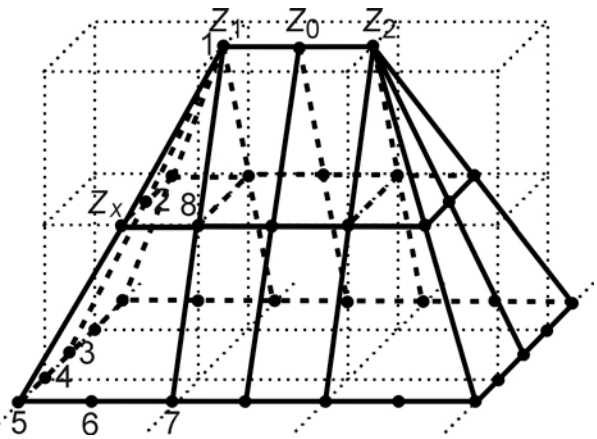

Fig. 4. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 7

We will make the structural description of the Z_x element in a tabular form (tab. 4).

Table 4
Structural description of the Z_x element No. 7

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions

1	0	2	the positive
2	1	2	the positive-planimetric
3	2	2	the topmost
4	2	1	the positive-planimetric

As we see, this element has one positive, one topmost and two positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 5).

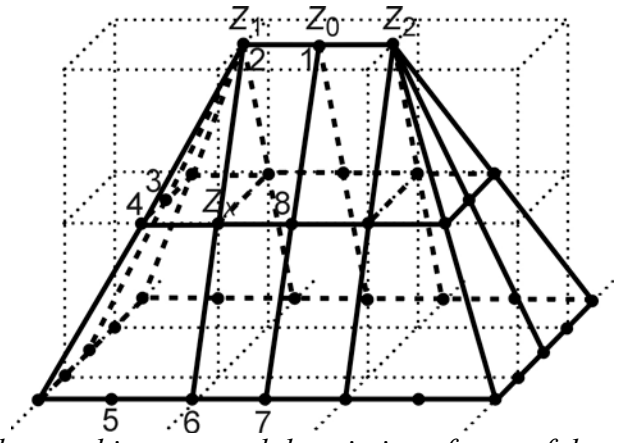

Fig. 5. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 8

We will make the structural description of the Z_x element in a tabular form (tab. 5).

Table 5

Structural description of the Z_x element No. 8

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	0	2	the positive
2	0	2	the positive
3	1	2	the positive-planimetric
4	1	1	the negative

As we see, this element has two positive, one negative and one positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 6).

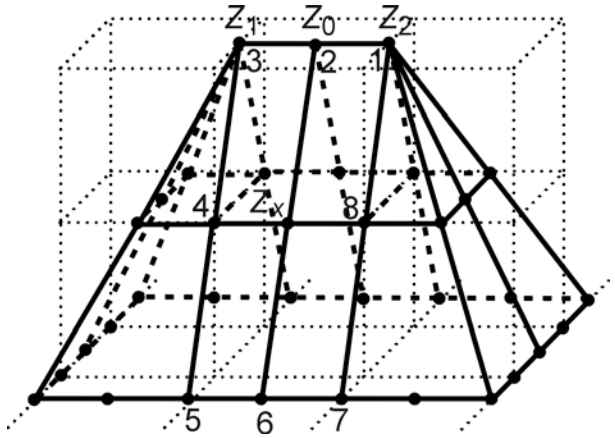

Fig. 6. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 9

We will make the structural description of the Z_x element in a tabular form (tab. 6).

Table 6
Structural description of the Z_x element No. 9

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	0	2	the positive
2	0	2	the positive
3	0	2	the positive
4	1	1	the negative

As we see, this element has three positive and one negative couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 7).

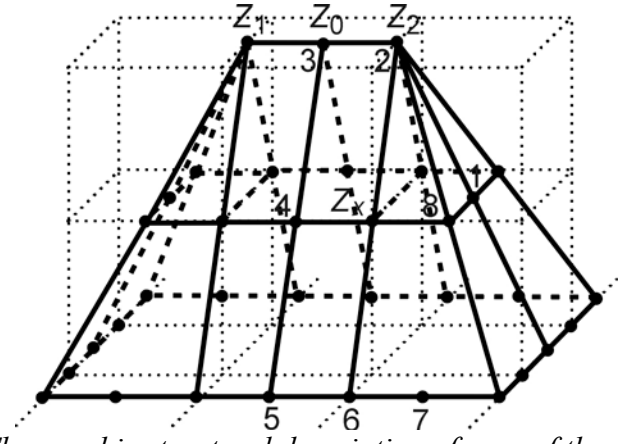

Fig. 7. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 10

We will make the structural description of the Z_x element in a tabular form (tab. 7).

Table 7
Structural description of the Z_x element No. 10

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions

1	1	2	the positive-planimetric
2	0	2	the positive
3	0	2	the positive
4	1	1	the negative

As we see, this element has two positive, one negative and one positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 8).

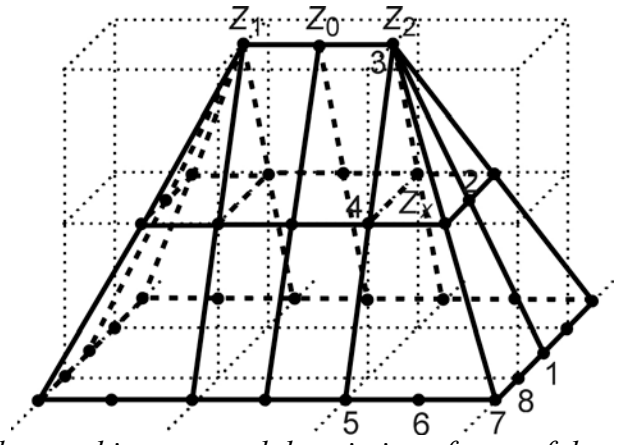

Fig. 8. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 11

We will make the structural description of the Z_x element in a tabular form (tab. 8).

Table 8

Structural description of the Z_x element No. 11

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	2	the topmost
2	1	2	the positive-planimetric
3	0	2	the positive
4	1	2	the positive-planimetric

As we see, this element has one positive, one topmost and two positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

We will advance the Z_x element on a drawing contour counterclockwise (fig. 9).

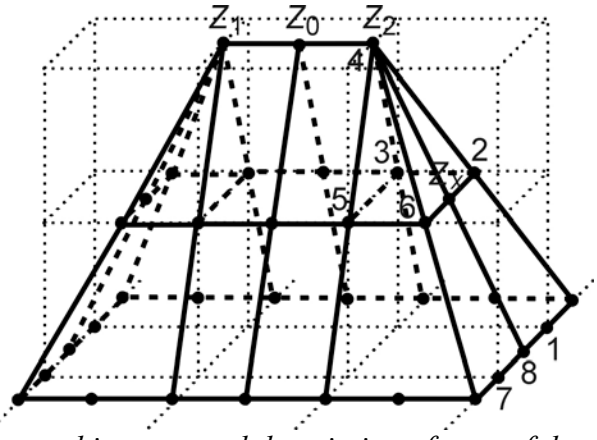

Fig. 9. The graphic structural description of area of the connected horizontally-positive elements with elements adjoining it No. 11.

We will make the structural description of the Z_x element in a tabular form (tab. 9).

Table 9
Structural description of the Z_x element No. 12

c	$p_{i,j,c}$	$p_{i,j,c+4}$	couple of directions
1	2	1	the positive-planimetric
2	1	1	the negative
3	1	2	the positive-planimetric
4	0	2	the positive

As we see, this element has one positive, one negative and two positive-planimetric couples of directions. From all these classes the highest level of a priority possesses positive => this element will be defined as positive.

As it was shown above, the Z_0, Z_1, Z_2 elements form area which will be defined how area of the connected horizontally-positive elements (h_1=1). Topmost elements, on applied system of classification, don't belong to the horizontally-positive => h_2=0. The sign of h_3 will be defined from the analysis of structural descriptions of the elements adjoining area. All these elements will be defined as positive => any of them h_3=1 will be defined as negative-planimetric, that is. At the beginning of the analysis the assumption was made that considering area doesn't adjoin edge of a raster scene, that is that the fragment isn't adjoined by any regional element. Thus, on a formula (1):

$$H = (h_1 h_3 \cup h_2) h_4 = (1 \cdot 1 \cup 0) \cdot 1 = 1 .$$

H=1 means that characteristic signs of the shaped image on a decreasing background will be created adequately.

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SOLVING OF MULTICRITERIA PROBLEM OF OPTIMAL SOFTWARE PRODUCT SELECTION

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The choice of the optimal software product using the decision support system based on expert assessments is considered. The vector criterion and software selection algorithm are described. The construction of the Pareto region of optimal models is described.

Keywords: vector criterion, optimal, software product, the Pareto region.

Currently, the problem of choosing suitable ERP systems especially regarding large financial costs for the acquisition and the implementation of these software products is very acute. One of the reasons for possible failures in the implementation of these systems is the discrepancy of the acquired software to the requirements of the organization [2].

The suggested solution of this problem is the decision support system (DSS), including the database on major enterprise resource planning systems and allowing to select the software according to desired characteristics.

Selection of a software product in the DSS is proposed to realise relying on the vector criterion that takes into account the presence of the necessary characteristics and the cost of the software product. Besides, the necessity degree of each marked characteristic is taken into consideration. The necessity degree is determined by expert assessments.

The selection criterion consists of two criteria $J_1(k)$ and $J_2(k)$. The criterion $J_1(k)$ is the presence of the marked characteristics. The criterion $J_2(k)$ determines the price of the k - th model, $k = \overline{1,K}$.

The criterion $J_1(k)$ describes the functionality of the k - th model and it is defined as the sum, where each term characterizes one of the groups of selected model parameters: logical, integer.

$$J_1(k) = J^L(k) + J^N(k), \quad k = \overline{1,K}. \tag{1}$$

To determine the components of the criterion $J_1(k)$, we introduce a boolean variable $S_j^i(k)$. The variable $S_j^i(k)$ possesses the value of «true», if the conditions of expert assessments for the k - th model for the j - th parameter of type i are satisfied, $(j,i) \in \{(g,L), (h,N)\}$, $g = \overline{1,G}$, $h = \overline{1,H}$, otherwise, there is an equation: $S_j^i(k) = "false"$.

Component criterion $S_j^i(k)$, which corresponds to the parameters PMIS of logical type has the form:

$$J^L(k) = \sum_{g=1}^{G} \mu_g^L \lambda_g^L(k), \quad g = \overline{1,G}, k = \overline{1,K}, \tag{2}$$

where the variable takes one of the values: $1, Z, 0$. The equality $\lambda_g^L(k) = 1$ means that in the optional presence of the g - th parameter in the k - th model for this parameter, the expert assessments should be satisfied. The equality $\lambda_g^L(k) = Z$ defines the conditions failure for the g - th parameter in the k - th model in a mandatory presence of the g - th parameter in the k - th model. Here Z is a numerical value of a fine equal to a big negative number $Z = -10^3$. In all other cases the value of the criterion should not affect the search of optimal solution, i.e. $\lambda_g^L(k) = 0$. The equality $\lambda_g^L(k) = 0$ defines a zero value criterion $J^L(k)$ for these conditions.

Thus, for the variable $\lambda_g^L(k)$ we have:

$$\lambda_g^L(k) = \begin{cases} 1, \text{if} \left(\mu_g^L \neq 5\right) \wedge \left(S_j^L(k) = "\text{true}"\right) \\ Z, \left(\mu_g^L = 5\right) \wedge \left(S_j^L(k) = "\text{false}"\right), \\ 0, else \end{cases} \quad g = \overline{1,G}, k = \overline{1,K} \tag{3}$$

Here the realization of necessary characteristics condition is determined by the following term:

$$S_j^L(k) = \begin{cases} "\text{true}", \text{if } l_g^L = "\text{true}" \\ "\text{false}", \text{else} \end{cases}, \quad g = \overline{1,G}, k = \overline{1,K} \tag{4}$$

The component of the criterion $J_1(k)$, which corresponds to the parameters of integral type system has the form:

$$J^N(k) = \sum_{g=1}^{G} \mu_g^N \lambda_g^N(k), \tag{5}$$

Where

$$\lambda_g^N(k)=\begin{cases}1,\text{if}\left(\mu_{\text{g}}^{\text{N}}\neq 5\right)\wedge\left(S_j^N(k)=\text{"true"}\right)\\ Z,\left(\mu_{\text{g}}^{\text{N}}=5\right)\wedge\left(S_j^N(k)=\text{"false"}\right)\\ 0,else\end{cases} \tag{6}$$

$$S_j^L(k)=\begin{cases}\text{"true"},\text{if}\left(\left(\lambda_{\text{n}}=-1\right)\wedge\left(y_h^k\le y_h^S\right)\right)\vee\left(\left(\lambda_{\text{n}}=0\right)\wedge\left(y_h^k=y_h^S\right)\right)\vee\left(\left(\lambda_{\text{n}}=1\right)\wedge\left(y_h^k\ge y_h^S\right)\right)\\ \text{"false"},else\end{cases} \tag{7}$$

$$g=\overline{1,G},k=\overline{1,K}$$

Here the logical variable $S_h^N(\text{k})$ determines the conditions implementation for the parameters of integral type for k - th model.

Thus, the criteria characterize the functionality of k - th pattern, i.e. functionality of each model MD_k is determined by their numerical value. This numerical characteristic is based on the requirements to a software product.

The criterion $J_2(k)$ determines the price of k - th type of EMIS model, i.e.

$$J_2(k)=d_k,\quad k=\overline{1,K}. \tag{8}$$

Thus, the criterion for selecting the optimal vector of the model is:

$$\bar{j}(k)=\left(J_1(k),J_2(k)\right) \tag{9}$$

The task of choosing the optimal software product is as follows.

For the list of characteristics, taken under advisement, that is determined by the set $S=\left\{L^T,N^T\right\}$, it is necessary to find such a model MD_k^* from the entire set of models $\left\{MD_1,MD_2,...,MD_k,...,MD_K\right\}$, for which the optimal value of the criterion $\overline{J}(k)$ is reached i.e.

$$\bar{j}^*\left(k^*\right)=opt\left(J_1(k),J_2(k)\right),\quad \text{for } MD_k=\left\{b_k,L_k,N_k,d_k\right\},k=\overline{1,K} \tag{10}$$

The Pareto principle is used to solve a multicriteria problem [3].

The wording of the Pareto principle can be written as follows: the efficiency of the solution can not be improved by any of the criteria, without impairing the other criterion.

In our case, if the k * - th Pareto solution is optimal, there are no other solutions k `, for which

$$J_1(k`)\ge J_1(k*),J_2(k`)<J_2(k*) \tag{11}$$

or

$$J_1(k`)>J_1(k*),J_2(k`)\le J_2(k*) \tag{12}$$

These inequalities formalize the Pareto principle, i.e. for the optimal solution of the optimal k * - th model there is no other k `- th model in which, with the same functionality features $J_1(k')=J_1(k^*)$ or better features $J_1(k')\ge J_1(k^*)$ the price would be less $J_2(k')<J_2(k^*)$.

Or the Pareto principle can be formulated differently: for the optimal k * - th model there is no other k `- th model, which at the same price $J_2(k')=J_2(k^*)$ or a less price $J_2(k')\le J_2(k^*)$ would have the best functionality $J_1(k')>J_1(k^*)$.

The result of solving of the multicriteria optimization problem is not a single value, but a set of values, which is called the Pareto region. All optimal solutions forming the Pareto region obey the Pareto principle of optimality: moving from one point of the Pareto region to another point of the region one criterion is improving and the other is impairing.

Figure 1 provides an algorithm for solving the multiobjective problem of optimal model selection.

At the initial stage, we realize the input of all parameters of the set of models $\{MD_1, MD_2, ..., MD_k, ..., MD_K\}$, the information model: $MD_k = \{b_k, L_k, N_k, d_k\}, k = \overline{1, K}$. Next, we form a list of characteristics $S = \{L^S, N^S\}$. After this the initial value J_2^0 of the criterion $J_2(k)$ is determined and the step ΔJ_2 of criterion change $J_2(k)$ is set.

For this we calculate a possible minimum value of the criterion $J_2(k)$ as the lower bound of the set: $J_2^{\min} = \inf\{c_1, c_2, ..., c_k, ..., c_K\}$, then the initial value is defined as the sum $J_2^0 = J_2^{\min} + \Delta J_2$. After that we find the k * - th model, which has the best criterion $J_1(k)$ for all models of the PMIS form: MD_k, for which $J_2(k) \le J_2^0$.

If the mandatory requirement of the objective is complied, i.e. Z = 0, the memorizing of k * - th model MD_k^* and the criterion $J_1^*(k^*)$ to the Pareto region is realized.

Next, with the step ΔJ_2, the criterion $J_2(k)$ changes from the initial J_2^0 to its final target value $J_2^{\max}$, which is the upper bound of the set: $J_2^{\max} = \sup\{c_1, c_2, ..., c_k, ..., c_K\}$. For each iteration we determine the K * - th model, which has the best criterion $J_1(k)$ for all models MD_k, in the range of the step ΔJ_2.

If this k * - th model satisfies the Pareto principle, and the mandatory requirements of the objective are carried out, i.e. Z = 0, then the memorizing of k * - th model of MD_k^* and the criterion $J_1^*(k^*)$ is done. The model k * defines a point of the Pareto region. Then, a new high price is selected, i.e. the criterion $J_2(k)$ increases by step ΔJ_2.

In the same way we define a new Pareto optimal k * - th model. The modelling of the Pareto region $\{MD_1^*, MD_2^*, ..., MD_k^*, ..., MD_K^*\}$ ends when the highest possible price, the boundary $J_2^{\max}$ of criterion change $J_2(k)$, is reached.

Here $\{MD_1^*, MD_2^*, ..., MD_k^*, ..., MD_K^*\} \in \{MD_1, MD_2, ..., MD_k, ..., MD_K\}, K^* \le K$.

Thus, by the algorithm work, we have a set of models of the form ACS, $\{MD_1^*, MD_2^*, ..., MD_k^*, ..., MD_K^*\}$, which form the Pareto region.

The Pareto region $\{MD_1^*, MD_2^*, ..., MD_k^*, ..., MD_K^*\}$ of models EMIS is basic for a software selection. According to the algorithm, the person, who makes a decision for choosing programs from the proposed Pareto region $\{MD_1^*, MD_2^*, ..., MD_k^*, ..., MD_K^*\}$, chooses a particular software product.

The software product selected from the Pareto region can be further tested for a more precise analysis of software product for the ratio of its capabilities with the needs of the organization. [1]

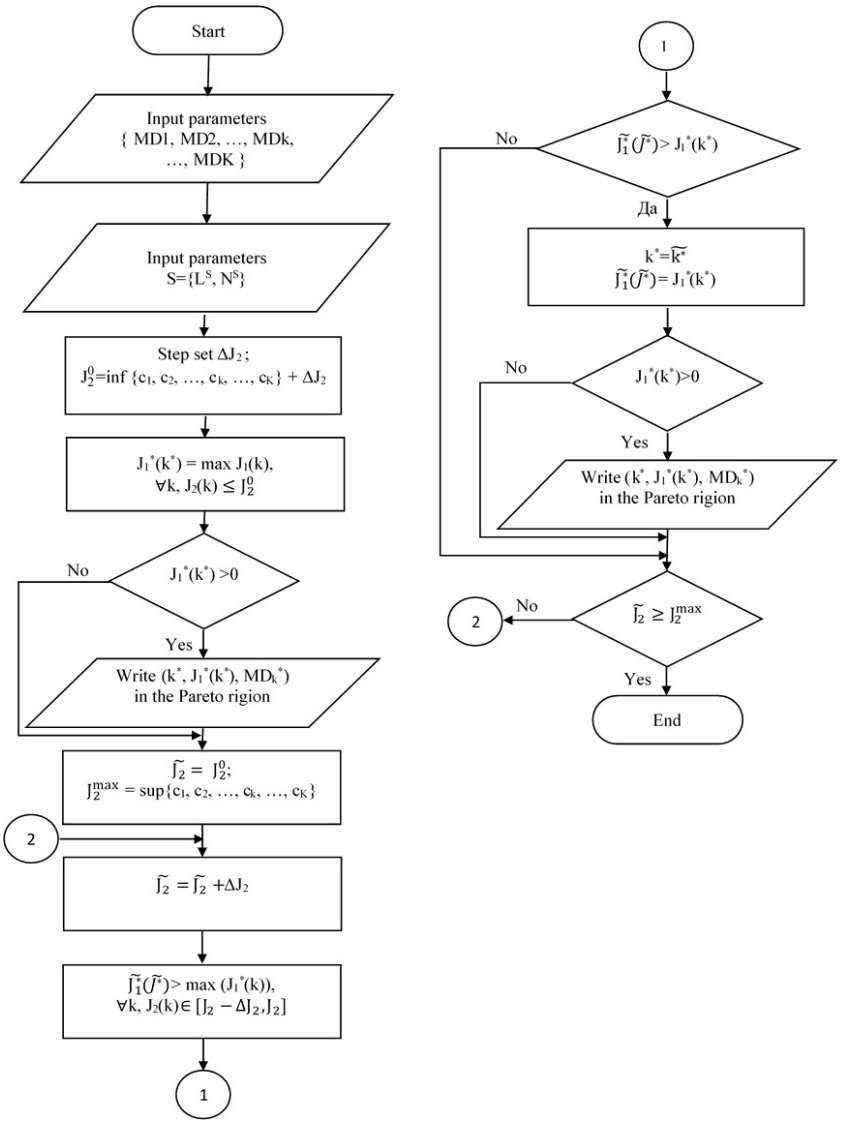

Figure 1 - Algorithm for solving the problem of selection

To select a suitable ERP systems we developed the algorithm for solving a multiobjective problem of choosing an optimal selection model of an appropriate software, the result of which is a set of optimal models forming the Pareto region.

Decision support system, using the developed algorithm, allows to identify software products, which are most appropriate to the specifics of the company and have the necessary characteristics. The most promising fields of use of this DSS is in companies working in specific sectors or developing industries.

The agricultural enterprises may be examples of such companies.

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SAMPLING TECHNIQUES IN METHODS OF MODELLING OF SYSTEMS OF THE AUTOMATED DESIGN OF ULTRAHIGH FREQUENCIES DEVICES

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There are various methods of modeling in systems of the automated design of difficult technical devices, techniques of sampling of studied area in final and differential methods in article, questions of a choice of a method of modeling for devices of the ultrahigh frequencies, allowing to calculate characteristics of difficult microwave structures and as program complexes of electromagnetic modeling and packages of the analysis of radio-electronic schemes and systems locates.

Keywords: technical solution, technical system, system of the automated design, design of ultrahigh frequency devices, modeling methods, numerical methods of modeling, sampling, triangulation, packages of applied programs, the software, programs of design of radio-electronic systems.

One of problems of modern science and equipment — development and deployment in practice of design of the latest methods of research of characteristics of difficult technical devices. At design of difficult systems (subsystems) there are the numerous tasks demanding an assessment of quantitative and qualitative regularities of processes of functioning of such systems, carrying out structural and parametrical synthesis [1 - 3].

The automated systems of design belong to the class of big systems, development stages, introductions, operation and which evolution now are impossible without use of different types of modeling [1, 2]. At all design stages of difficult technical devices it is necessary to consider the following features:

- complexity of structure and uncertainty of connection between elements, ambiguity of algorithms of the solution of an objective;
- large number of variables and incompleteness of initial information;
- variety of influences of factors of environment.

Limitation of opportunities of the experimential research of big systems does a technique of their modeling actual development which would allow to present processes of functioning of systems in the corresponding form, the description of course of these processes by means of mathematical models and to receive necessary estimates of characteristics of studied objects.

The method of modeling and necessary specification of models significantly depend on a development stage of difficult system. At stages of inspection of object and development of the specification on design of the automated system of model, generally have descriptive character and pursue the aim in a short and simple form most fully to provide information on the object, necessary for the developer of system.

At development stages of technical and working projects of systems, models of separate subsystems are detailed, and modeling serves for the solution of specific objectives of design, i.e. a choice optimum by a certain criterion at the set restrictions of option from a set of the admissible. Therefore generally at these design stages of difficult systems models for synthesis are used.

The analysis of technical systems in systems of the automated design (SAD) is based on mathematical modeling, i.e. on research of designed systems. In SAD tools of the analysis are directly connected with instruments of synthesis. In particular, problems of synthesis often manage to be reduced to the repeated solution of the corresponding tasks of the analysis. Application of SAD allows to find the design solution.

Traditional methods of modeling in systems of the automated design of difficult technical devices are stated in numerous works [4 - 7].

Machine orientation of traditional methods of modeling for the purpose of their application in SAD consists of extending them to multidimensional systems of a high order, to determine quality of their desi gn not by one, and by many criteria, having simplified thus procedure of receiving the end result [8].

For all methods of design of difficult technical systems the following features are characteristic:

- structurization of process of design, allocation of stages and design stages;
- iterative nature of design;
- typification and standardization of design decisions and design tools.

For the automated design of difficult technical systems by the main question is formalization of methods of formation of mathematical models of devices and elements of systems. Efficiency of application of SAD, so and quality of design depends on extent of automation of procedures of obtaining the mathematical description as a whole. It is necessary to remember what exactly the method of receiving the mathematical model, realized in SAD, in many respects defines characteristics of the received model of system as a whole.

Speaking about devices of ultrahigh frequencies (UHF), this direction in which systems of the automated design develop very intensively.

Development of systems of the automated design of devices of ultrahigh frequency range is dictated by need of reduction of time and material inputs on prototyping and debugging works. After all the traditional way assumed creation of a set of devices (models) and carrying out with their help of numerous skilled researches [9, 10]. The greatest complexity was caused by modeling of UHF devices with difficult geometry [11]. Modern applied programs help with research such tasks [12]. It is at present difficult to present process of creation and research of the difficult UHF devices without application of the electromagnetic simulators reducing the price and reducing the time process of development of the new device.

The wide choice of software for modeling of passive and active structures is presented to modern designers.

Such core methods became a basis of the software for design of the UHF devices as: method of final differences (FDM); method of final elements (FEM); method of matrixes of transmission lines (TLM); method of the integrated equations; method of the moments (MoM) and Galerkin's method, and also: method of a cross resonance; method of the generalized matrix of dispersion; calculation method in spectral area. These methods count characteristics of difficult microwave structures.

The greatest distribution in serially let out SAD gained: method of final elements (FEM); method of the moments (MoM); method of final differences in a time domain (FDTD).

In these three methods the same approach to modeling is traced. Process of modeling can be separated into the following stages:

1. Topology (the description of geometrical parameters of structure, is more often creation of physical model by means of the visualization tools which have been built in the program) and a task of properties of materials.

2. Installation of parameters of electromagnetic modeling (description of area of modeling and boundary conditions).

3. Modeling (sampling of physical model, splitting into cells; field approximation in each cell by means of basic function thus coefficients of function are selected until boundary conditions) will be satisfied.

4. The processing, the obtained data (calculation of S-parameters, radiation characteristics in a distant zone and so on).

But there are also differences between application of the specified methods. The method of the moments is suitable for planar structures whereas the method of final elements and a method of final differences in a time domain are methods for calculations in volume more. The matter is that at application in SAD of two last methods volume, and in a method of the moments - only metal parts of a design is sampled (breaks into elements, for example tetrahedrons). It is enough of it as unknown size in a method of the moments is distribution of currents on a metal surface whereas in two other methods define distribution of an electromagnetic field in space. Performance of full three-dimensional calculation of an electromagnetic field often is necessary as not all parts of the real device can be subjected decomposition on the elements which are storing in libraries of models.

Difference between a method of final elements and a method of final differences is in a time domain that in the first - Maxwell's equations are solved indirectly through matrixes whereas in the second method is becomes in an obvious form.

As examples of application of the specified methods it is possible to enumerate the following software:

- method of final elements – Ansoft High Frequency Structure Simulator 8 и выше, Agilent High Frequency Structure Simulator 5.6;
- method of the moments – IE3D, MWO - Microwave Office, Momentun 2.0;
- Galerkin's method – Microwave Office;
- the modified method of the moments – Sonnet;
- method of final integrals in a time domain – CST Microwave Studio;
- method of the final - differences in a time domain – FIDELITY(фирма Zeland).

The development of means of computer modeling led to creation the systems which are working with different computing methods, for example, ANSYS company DesignerRF&SI system.

The vector of development of scientific thought of creation of designed programs of radio-electronic systems tends to integration of various systems of design into the uniform information environment in which there is a possibility of development of various devices from digital schemes of processing and formation of signals to UHF schemes and antennas. The uniform information environment is characterized by interpenetration of results of work of different programs for the purpose of creation of the project of all radio-electronic system as a whole. The full analysis of products of the radio-electronic equipment is interesting to end users, since physical prototypes and finishing the analysis of all product taking into account influence on it various factors of operation.

The example can be the environment of Ansys firm – Ansys Workbench under control of which can work as modules of electromagnetic modeling (HFSS, Q3D, Maxwell), and programs of the analysis of radio-electronic schemes and systems (Designer RF&SI and Simplorer). Any of the specified software products through the Ansys Workbench environment can be also integrated with tools mekhaniko-and the gasdynamic analysis, the thermal analysis. Development of means of computer modeling allowed to make integration of packages of different computing methods in Designer RF&SI system.

The questions of integration of systems of different producersare important. For example, software products of Cadence firm can be integrated with simulars. For this purpose the Solver on Demand interface simplifying data transmission was in common developed. That

is it is possible to perform tunings for modeling in the environment of Cadence Allegro and to transfer them to Ansys HFSS.

Support of libraries from third-party producers of radio-electronic components allows developers to design systems taking into account modern technological norms.

Progress of automation of design in areas of modeling and the analysis, parametrical and structural synthesis forms base of further development of information systems and the technologies used in productions.

The understanding of physical processes proceeding in the device, competent design both the subsequent designing and production is impossible without mathematical models effective, moderately simple and available to the engineer.

With development of the computer equipment there was a possibility of application of numerical methods with difficult mathematical apparatus. For example, method of final elements which is one of direct methods of the solution of boundary tasks. This method attracts developers with the universality for a long ago, opportunity to solve problems from the analysis of the waveguide and strip structures before modeling of antennas and the difficult not mutual devices containing girotropny environments. However its application restrained the big time expenditure necessary on sampling of space. After all the first programs didn't assume automatic splitting area into elements, all of them were brought together to that internal knots have to be already defined, that is they were set by the user.

The modern software contains the special modules solving this problem. For example, in library of the ANSYS company more than 80 types of elements of the splitting which application is defined, both geometry of studied object, and physical properties of area of calculations are. Using these elements, the program can independently construct a splitting grid. However requirements to level of automation of splitting areas everything increase.

Techniques of sampling or splitting studied area into not being blocked elements are discussed by scientific community and at present. As basic triangular elements (triangulation) usually consider.

There are many various approaching to the solution of a task on an area triangulation:

1. Grid imposing on realization area. It is impossible to call this method very effective for areas with rather any border, that is for areas where the border is strongly distorted, boundary conditions will be badly considered or it is necessary to apply a large number of small elements of splitting (triangles).

2. Area section in knots straight lines parallel to axes of coordinates, or lines which are continuations of the parties (for the areas having piecewise and linear border). After section polygons turn out. Positive side of this approach is that circumstance that all polygons convex. It is possible to carry out their triangulation. The negative moment is that, as well as in the first case, elements can be very small. For example, in figure 1 the area sampled in this technique is shown.

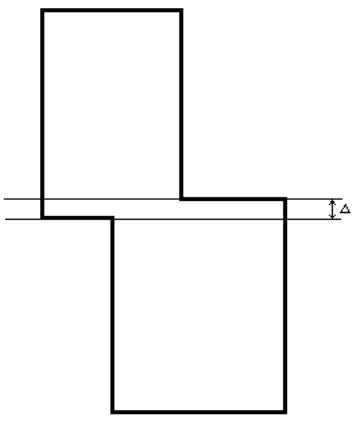

Figure 1

There is a question: what size are the triangles? Certainly with the parties comparable with Δ. Separating all polygons into elements with the party approximately equal Δ, we will receive big expenses on time as Δ it isn't enough.

3. Crushing by similar figures. It is suitable for convex figures as not convex can have self-crossings.

4. The great interest is represented by idea of use of quasiconformal displays. It is based on theorem and consequence use from it, given in L. Alfors's book «Lectures on quasiconformal displays». Any figure, which internal corners 60 or 120 degrees, it is possible to break into equilateral triangles. If to such area to apply the display described in a consequence, it is possible to receive quite a new area, and the main thing this area will be already triangulated. In other words the purpose of this approach consists of effectively to execute a triangulation of initial area by means of kvazikonforny display of this area to another, which splitting to triangles doesn't cause difficulties.

It is possible to present one more algorithm of approximation of area the triangular elements, offered in Astafurova O. A. early works. The essence of a method consists of the following. The convex area and its border undertakes it is represented in the form of the broken line. Further there is smaller on length a broken line link. Concerning this link the triangle party (a splitting step) gets out, it has to be smaller or equal. How this size is set, the grid of splitting will be larger or more small. Then knots are renumbered. Beginning from knot with the first number, the corner formed by this knot and two next on border if it more than 90 degrees are carried out a beam at an angle equal to a half calculated (a corner is calculated postponed from border). On a beam the distance equal to a splitting step is measured. Coordinates of new knot are calculated. From the constructed knot pieces to the next knots on border are carried out. And so on. Movement happens spirally. Process stops when the current border consists of three elements.

Concerning this algorithm the program which showed rather good results for one-coherent areas without self-crossings was written. Areas with self-crossings were offered to be broken manually into subareas without self-crossings and to apply the program for everyone. For not one-coherent areas it was offered to make a section, and on it to consider knots twice, doing round so that the area was always, for example, at the left.

In the conclusion it is necessary to emphasize importance of fundamental development, after all theoretical bases found the application in modern program complexes were developed 30-40 years ago. Today such researches are financed, as a rule, at the expense of public funds as the concrete firm, and all society is interested in the end result not. Therefore the attention of the management of the state is vital for further development of science.

On 24th of December, 2013 the Government of the Russian Federation approved the Concept of development of mathematical education which represents «a frame of reference on the basic principles, the purposes, tasks and the main directions of development of mathematical education in the Russian Federation».

Realization of transition to a way of a sustainable development of fundamental science will lead further to development of deeper methods of modeling that in turn will give an impetus to a new level of development of systems of the automated design.

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WIRELESS HETEROGENEOUS NETWORK FOR MONITORING AND SUPERVISORY CONTROL AT URBAN HEATING SUPPLY SYSTEM

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The paper describes the functioning of the SCADA system for urban heating supply system. The proposed structure enables a stable and reliable data transmission from the modular boilers and central heating stations to the central dispatch server as well as the commands from this center at the PLC (Programmable Logic Controller) automation devices. The connection between the heating stations and the dispatch center is established with wireless data transfer using sensor networks (ZigBee) and mobile cellular networks. The operator in the dispatch center can monitor the functionality of the district heating networks on the SCADA screen, and alarm reports assist in locating faults, which contributes to a significant increase in maintenance efficiency.

Keywords: Monitoring, support decision, heating supply system, energy consumption, energy efficiency, SCADA, wireless sensor network, heterogenic network

Introduction

The main objective of district's water and heat supply of the city is to ensure consumers a desired quality hot and cold water for a given level of comfort and conditions payment of these services depending on the volume of consumption. In most region of the Russian Federation, the urban heat supply traditionally ensured by powerful central heating systems (CHS) based on thermoelectric steam power plant with cogeneration turbines of various capacities. District heating is a technology that transports energy in the form of hot water or steam from a central heat plant to customers, used mainly for collective heating systems in residential quarter of blocks with dense buildings. District heating supply system (DHS) is created on the basis of central heat supply stations (TSC), where located not only heat power equipment, but also plumbing, gas, electrical and fire-fighting equipment, making them centers of energy services. The buildings of different types of energy from the sources of its generation (cogeneration heat and power plants, boiler-houses and others) is served in four-, six-, and eigth-pipe distribution heat-supply pipelines.

In such systems, district heating power TSC taken from 12 to 35 MW (the sum of the maximum heat flux on the heating and the average hourly flow for hot water). Currently used transportable modular boilers-houses (MBH), which allow to reduce the cost of thermal energy by reducing the cost of heat supply stations, losses for transporting energy to the buildings on the pipelines. Individual heating items (IHI) is based on producing heat energy by the heating equipment inside a building. Such way of heating is typical for DHS in Russia. DHS satisfies demands of significant part of the customers both residents and industrial clients.

The main problems

The disadvantages of DHS might include:

- low energy efficiency and great heat losses during energy transportation ,
- lack of technologies automated regulation at heat-separate buildings, depending on weather factors (outdoor temperature, wind speed and direction, pressure, humidity, etc.),
- lack of automatic possibility rapid transition to reduced or elevated temperature schedule depending on current weather conditions,
- low reliability heat and water supply systems,
- limited ability to backup thermal power heat sources due to the concentration of thermal power on TSC and radial structure deadlock heating networks,
- a significant imbalance of heat and overrun heat energy (30-50% of the calculated values),

A fundamental problem with transporting heat energy is losses to the surroundings during transportation due to insufficient insulation of the distribution pipes and heat substation leaks because of usage defective pipes and equipment. In Russia, energy losses in the distribution network can reach up to 70% in old and poorly maintained systems. Emergency situations at the district heating source or central pipelines of heating networks can lead to significant and long breaks in the heat supply to consumers and etc.

To solve the problems to be a shift from the district heating system to individual heat supply at buildings and individual consumers. This scheme will allow, to approach heating system to the end user, to reduce costs and losses during transportation heat energy. Secondly, necessary to go at the individual accounting energy for the end user. Third, the introduction of energy management systems will enable operative building energy management, depending on the changes in various internal and external factors, with the abandonment of the existing rules and regulations [1].

The most problems is solved by using a decentralized system with individual house or apartment heating points (IHP). Heat transfer points closer to end consumers increases the effectiveness of automatic thermal regulation heating, hot water supply quality. With automatic

correction of thermal schedules depending changes in the outdoor and indoor temperature reaches a great heat savings. The problem also is practically solved by installing in each building buildings and individual metering devices of heat and water. Complex systems of intellectual analysis and forecast heat and hot water consumption for urban district and individual buildings are still only beginning to be created. Solution of the third problem also is still in the initial stage, in spite of the existing experience in creating energy management systems in Europe, where in 2011, operates an appropriate standard ISO 50001:2011 [2].

Decision support system

For monitoring and analyzing the parameters of the heating consumption, as well as characteristics of the operations to improve energy efficiency and reduce fuel consumption and heat losses in the generation, transportation, consumption and disposal of heat energy, is developed and implemented SCADA system. The main purpose of these systems is automated data collection and data processing about heat consumption objects. Today SCADA (Supervisory Control And Data Acquisition) is a system for measuring, data collection, monitoring and control of industrial systems [3]. The SCADA network consists of one or more MTUs (Master Terminal Unit) which are actually computer stations equipped with appropriate software and operating system. These stations are used by operators to monitor and control one or more RTUs (Remote Terminal Unit). RTU is also a computer device which is typically designed for use in industrial environments. Its job is to collect data from a digital and analog sensors or transmit commands to devices which in some way alter the status of the managed system. The standard of different wire networks (Ethernet, Modbus, ProfiNET, etc.) are used for data transfer between MTU and RTU [4].

However, as in the case of DHS, and the introduction of IHP, it is necessary to develop decision support system (DSS) with OLAP, situational analysis, forecasting to optimize energy consumption and energy efficiency with the ability to rapidly respond to changes in different factors [5]. Such systems are designed to upgrade dispatching SCADA systems. The synthesis and implementation of the decision support system (DSS) has a goal to achieve energy efficiency in the process of supervisory control and accounting. The main functions of the DSS, we assume the following:

1) Collection and processing telemetry information to the dispatch server about the heating objects, heat and hot water consumption;

2) Data transmission to the dispatch server via the heterogeneous wireless network in various ways depending on the object distance (using directional antennas, the intermediate repeaters, GSM/GPRS cellular modems);

3) Preparation of timely and accurate information on energy use in real time;

4) Cloud management data warehouse to support decision-making on energy efficiency, reducing energy losses, protection of utilities, population and energy;

5) Operational control of the process heat generation, heat and hot water consumption when changing external factors;

6) Accounting and control costs for the use of various forms of energy;

7) Acquisition, processing and analysis of information on energy for heating units and buildings;

8) Multivariate analysis and forecasting of energy consumption on heating units and end-users;

9) Monitoring of abnormal and emergency situations at heating units and heat pipelines;

10) Modeling and evaluation of crisis situations in relation to objects, subjects and energy and evaluate possible consequences;

11) Forecasting threats to the population and engineering communications, the study of the dynamics change their protection, depending on natural, technological and human factors

12) Analytical processing of data using a multidimensional and geospatial analysis to visualize and provide the results of analysis, forecasting and modeling for decision-makers

13) Decision support for the implementation of measures to ensure the safe operation of utilities, safe transporting energy, prevention and localization of crisis situations and emergency response;

14) Providing safety of information resources for decision support systems from unauthorized access and other information-related threat

15) Remote access to the monitoring results and multivariate analysis of mobile communications. Locating and tracking the movements of mobile communications managers [16] and emergency repair services for timely alert decision-makers about the events at the monitoring objects in order to implement contingency management and prevention of abnormal and emergency situations;

16) Presentation and visualization of information in the form of structured reports, charts, graphs and recommendations. Presentation of the monitoring results to display on city maps, plans and schemes of engineering communications using GIS technologies (Fig. 1).

Heterogeneous wireless network

Heterogeneous networks for monitoring of heat supply system may include [6]:

1. Terminal clusters of ZigBee network with sensory nodes associated with industrial automation devices, various sensors, fire and security alarm systems, which are running coordinator.

2. Terminal clusters of Bluetooth network with nodes associated with industrial automation devices, various sensors, fire and security alarm systems, which are running master device [7].

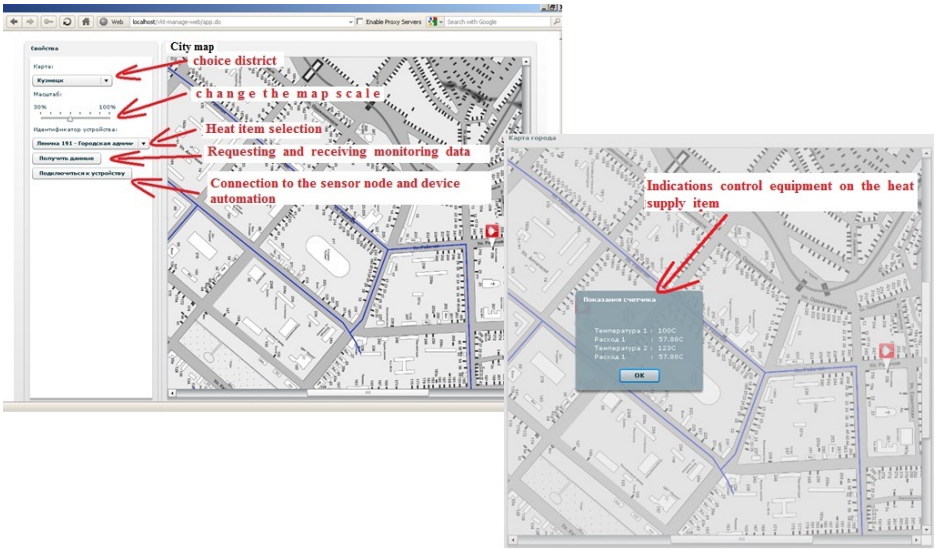

Fig. 1 Visualization telemetry data on city maps

3. Cellular network of mobile operators to collect data from remote sites which are difficult or not economically feasible to maintain the chain of sensory repeaters.

4. Satellite navigation system for the transport monitoring of company's vehicles.

5. WiFi or Ethernet LAN segments on a heat points and control rooms.

6. Internet segment to remote access to information resources SCADA system.

To ensure the required communication range in urban environments, you can use the following methods of data collection via wireless network:

1) Installation and connection GSM/GPRS modems to relay collected data with heat calculators and other energy meters via a cellular network. As a method of transmitting

information, GSM-systems use SMS-messages, modem connection (CSD), the transfer of parcels tone mode (DTMF) and a packet messages (GPRS). For today a wireless system based on GSM are widely used due to their relatively low cost and simplicity of installation and operation. Controllers with built-in GSM modem installed on objects the heating network and ensure the collection, storage and processing of data from a variety of meters (electricity, heat, gas meters, etc.) with subsequent transfer to the dispatch server via GSM / GPRS-connection channels. However, a significant disadvantages of these systems is low jamming immunity, low stability of cellular communication, openness cellular network to a variety of attacks, depending on the workload of the cellular network's, financial dependence from the provider cellular network.

2) Installation and connection of sensor nodes Zigbee on objects the heating network (TSC, MBH, pipelines), their amalgamation into a cluster of sensor network (Fig. 2), facilitates the wireless communication cluster coordinator with the central control server, using:

a. remote antennas with a high gain;
b. low-power sensor network intermediate repeaters, that can be installed:
   - at high buildings or poles of power lines;
   - On the ground measuring terminals for underground heat pipelines with remote control leaks, which are set at 300 meters. In this case, the repeater can also be used for leak detection and localization.

Wireless sensor network are ideal for the implementation of the DSS and SCADA [9]. The sensor network is an infrastructure comprised of sensing (measuring), computing, and communication elements that gives an administrator the ability to instrument, observe, and react to events and phenomena in a specified environment [10]. There are four basic components in a sensor network: (1) an assembly of distributed or localized sensors; (2) an interconnecting network (usually, but not always, wireless-based); (3) a central point of information clustering; and (4) a set of computing resources at the central point (or beyond) to handle data correlation, event trending, status querying, and data mining. The sensor units is used the so-called sleep mode and sends data to the master device only on call or in case of alarm detection [11]. In this case the company uses a virtual private network for the collection of data, that allows to provide the information security of the SCADA system, reduce the cost of services to providers of cellular network, eliminate dependence on them [11].

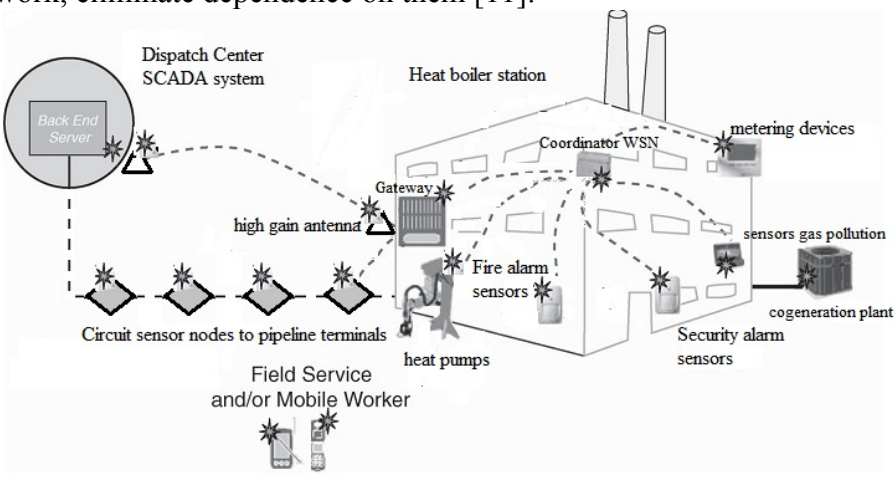

Fig. 2 Sensor network cluster (Zigbee) at heating items (TSC, MBH)

At the organization direct data transmission channels on the server on the terminal heating units installed directional antenna type ANT 2.4 YA-R03 (Pro-Cell) with a gain of more than 12 dBi, which provides connection to 10 miles in direct view, which is enough to create a wireless network in the urban district. If in urban areas is not possible to provide direct radio to

transmit data to the control server, you can use the repeating intermediate sensor nodes that provide technologies for building sensor network mesh topology, Such nodes WSN can be installed on power poles or tall buildings to provide power supply to devices.

Another interesting solution is to place the sensor repeaters on the inland terminals, which are equipped with modern underground heat pipelines with a wired remote control system (RCS). This is possible if the urban heat network uses double pipes with internal insulation and wiring system for the control of the moisture insulation. Connecting to the RCS conductors is performed by the measurement points, called terminals, which are connected to the pipe conductors and is outputted to surface (Fig. 4).

According to the standards terminals set every 300 meters and on the branches over 30 meters, and the final - at the ends of the track. This wire system pipe in the insulating layer can be used to supply power to the sensor nodes. Thus wireless repeaters terminals will be used to transfer data from sensor nodes installed in heat points, along the chain to the dispatching server.

For large urban areas in terms of creating a reliable transport medium for telemetry data collection and transfer should use all types of available wireless networks [12]. This will create a reserve data channels. In this way can to submit the wireless heterogeneous network for collecting and processing data from geographically distributed technogenic objects to support the dispatch SCADA system (Fig. 3).

Conclusion

Decision support system based on distributed monitoring instrumentation and control equipment of energy consumption on objects of engineering communications can improve management efficiency, optimize energy consumption, implement a system of early warning freelance and emergency situations, minimize repair costs of engineering communications.

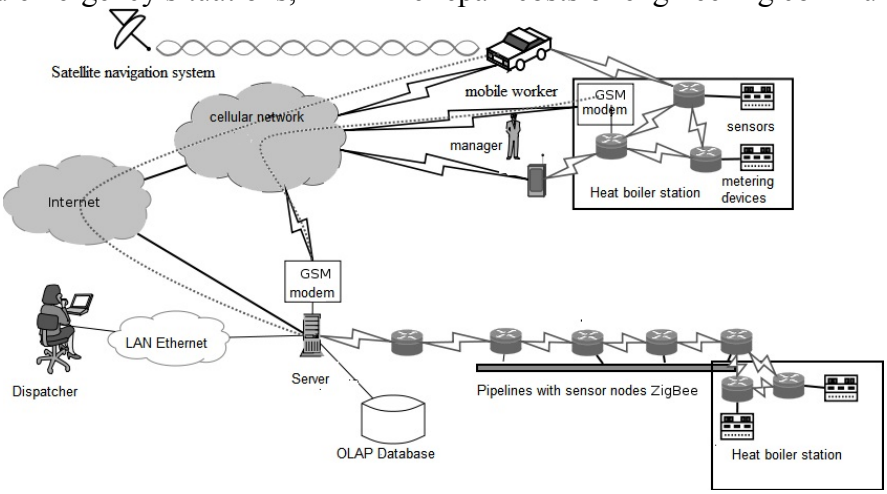

Fig. 3 - Wireless heterogeneous network for SCADA system

In conclusion, we list a number of major challenges, that arise before developers of SCADA systems for dispatching services:

1. The problem of "opacity" of information. It is known that most of the information systems implemented even within the same company, store data and results in a form unsuitable for use by other systems. Software developers and hardware do this intentionally to get consumers to buy only their products. Proprietary protocols and data formats does not allow to transfer them to another program or or require significant financial, time and labor costs. The company falls into the "informational dependence" from the developer, which is exacerbated by the termination of technical support on his part and can lead to catastrophic consequences.

2. The problem of information's mismatch. This problem is related to a variety of hardware and software systems from different manufacturers to collect and process data and assign them to a specific task. Today, manufacturers of equipment only produces for the heat supply system more than 60 types of devices for data collection and processing parameters with uncoordinated data sets. At different enterprises often use the same data that is collected and stored in various formats, which leads to a mismatch in the data when solving common problems or merger databases. Synchronizing data requires considerable effort and corresponding costs, and control this process is often impossible.

3. The problem of mismatch of information flows in networks. Network technologies to tackle the problem of information mismatch in different departments. However, the absence of a common policy in the use of telecommunications solutions and hardware from different manufacturers and providers leads to a mismatch of information flows in different network segments.

4. Problem of accounting for industry-specific data. The problem is related to the solution of specific tasks within different companies, classified information to third party companies and complexity of information sharing between agencies for various reasons.

5. Problem associated with the lack of energy management systems in the urban heating system. This problem is largely determined by the absence of a single mechanism of interaction between producers and consumers of thermal energy, the presence of intermediaries in the chain of supply of heat energy to the final consumer.

Discussed problems hamper the introduction of new technologies to support decision making, forecasting and energy management and thermal points of heat consumption of buildings to achieve the required energy efficiency.

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USING DATA MINING TO CONSTRUCT A SOCIAL GRAPH AND AFFILIATION NETWORK

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In the last decade the amount of data available in Internet has been dramatically increased. Recent advancements in technologies have allowed more data about activities to be collected. Knowing patterns of relationships is very useful for businesses to sell products, for law enforcement to investigate collaboration among suspects and in many other areas. This work describes approaches how to mine the data instances where several actors co-occur in space and time reasoning that individuals who are frequently found together are likely to be associated with each other.

Keywords: social graph, affiliate network, data mining

Introduction

In the past few years, the idea of networks as a unifying theme to study "how social, technological, and natural worlds are connected" has emerged as an important direction within theoretical Computer Science.

Social network describes a group of social entities and the pattern of inter-relationships among them. What the relationship means varies, from social nature, such as kinship or friendship among people, to transactional nature, such as trading relationship between countries. Despite the variability in semantics, social network share a common structure in which social entities, generally termed actors, are inter-linked through units of relationship between a pair of actors known as: tie, link, or pair. By representing actors as nodes and ties as edges, social network can be represented as a graph called a social graph. For social graph the notation $G_s=\{V, E_s\}$ is used where V is a set of nodes corresponding to actors that participate in the graph. Nodes form ties that are directed or undirected. Notation $e_s(v_j, v_j, t)$ denotes a tie from v_i to v_j formed at time t. A directed link represents a situation when one actor links to another while undirected link requires both parties to link each other. There are other examples of application-specific graph structures:

Internet graph is the graph whose vertices are computers and whose edges are network links. One of the first observations that led to the interest in random graph models significantly different from the classical Erdős–Rényi models comes in the work of Faloutsos et al.[1], who noticed that the degree distribution of the Internet graph is heavy-tailed, and roughly obeys a "power law," that is, for some constant $\alpha > 0$, the fraction of nodes of degree d is proportional to $d^{-\alpha}$.

Web graph is the graph whose vertices are web pages, and whose directed edges are hyperlinks among web pages. Similar observations were made about the web graph by Barabasi and Albert [2], who also presented models based on the notion of "preferential attachment" wherein a network evolves by new nodes attaching themselves to existing nodes with probability proportional to the degrees of those nodes. The web graph is an example of a scale-free network.

Affiliation networks. In affiliation networks $G_a=\{V, H, E_a\}$ there are two types of entities: actors (V) and society, groups or events (H), that are related by affiliation of the first in the latter $e_a(v_i, h_j, t)$. These relationships can be naturally viewed as bipartite graphs. The social graph among the actors that results from the bipartite graph is obtained by "folding" the graph by replacing paths of length two in the bipartite graph among actors by an undirected edge. The central thesis in developing a social graph as a folded affiliation network is that acquaintanceships among people often stem from one or more common or shared affiliations: living on the same street, working at the same place, being fans of the same football club, having coauthored a paper together, etc.

Affiliation networks are not new, this terminology exists in sociology, and a fundamental 1974 paper of Breiger [3] appears to be the first one to explicitly address the duality of "persons and groups". Breiger notes that the metaphor of this "dualism" occurs as early as in 1902 in the work of Cooley.

Knowledge of social structures is useful in various areas. In marketing, graph organized by books buying data: two books are linked if they were bought by the same person is used to provide suggestions: "You may also like…" In law enforcement concerning organized crimes such as money laundering knowing how violators are connected to another world would help to identify additional suspects or disrupt a criminal act. Members of social networks may also get an advantage to use their connections to get know or stay in touch with others.

Despite its many uses the social graph is difficult to construct because a tie between a pair of actors is a property of the pair rather than a property of either actor. Finding data of n actors transforms to collecting properties of $n(n-1)/2$ pairs of actors. The same applies to affiliation networks. Moreover, the classical means of collecting such data by social scientists, especially when done carefully and reliably, are difficult and time-consuming. This involves questionnaires, interviews, direct observations, manual scanning through archival records etc. [4] This is suitable only for small group of entities. In case of wide application of affiliation network the analysis requires the ability to construct a large social graph quickly which can be achieved using computation methods capable dealing with huge amount of data.

Data sources

Vast majority of mass-media provide online access to the news. Search engines might be used to look for pages mentioning particular subject. In the addition to the traditional information sources like web sites and news portals, people produce huge amount of terabytes of information every day posting them to blogs, micro-blogs and social network pages. Privacy is disrupted since people can easily post any information regarding any subject without approval. This raw data is a perfect source to analyze. For example, Twitter posts are short and partially structured. Faces on Instagram photos could be matched to real persons using various face-detection algorithms. Moreover, most of the social networks have a feature to tag matching persons on photos or match persons to geographic location.

Having web graph $G_w=(P, L)$ containing web pages mentioned above, we can translate using natural language processing methods every web page to a database of mentions D containing tuples $d=(d_a, d_o, d_l, d_t)$ where d_a represent actors uniquely, d_o indicates the occupation of this actor in location d_l at the time d_t.

Using data mining to construct an affiliate network

At first we look at computationally mining social network from spatiotemporal data. Each unit of such data has an associated location and time. Assuming that each data is attributed to specific actor, the subset of data for an actor describes the series of locations visited by the actor over time. For example, this might be tracking of physical location of moving objects or logging locations where some actor-associated event happened. In this context spatiotemporal coincidence is defined as occurring together in space and time. This coincidence is basis for deducting association between people and affiliate object. Taking into account the number and the frequency and the other properties of such coincidences some information about their relationship can be mined.

In addition to coincidences we can use these criteria to set ties between actors and affiliate object: self-report, communication and similarity.

Self-report uses only links reported by individual actors. Usually these links are directed and naturally subjective. For example we can use data from homepages, profile pages in community sites like LiveJournal and Google+, connections from Facebook, VK and similar social sites. Similar data might be acquired from instant messaging buddy list.

Communication, defined generally, as a transfer of information or resources is common among socially related people. Inversely, evidence of communication may indicate association. Among others, such evidence may come from electronic communication. Examples where the electronic trails of communication can be traced include emails, newsgroups, and instant messaging. Links based on communication are directed, from the originator to the recipient.

Similarity has its foundation on the sociological idea that friends tend to be alike [5]. This leads to the premise that the more people have in common, the likelier it is that they are related. For example, social site profiles with similar textual content and linkages may represent a group of related individuals. Other forms of similarity include having the same communication partners and sharing the same opinions or areas of interest. Similarity-based links are undirected. [6]

Coincidence assumes if several entities occur together more frequently than random chance alone would allow, they may be associated. Like similarity, it is by nature undirected and symmetric. The work on connection subgraph uses a huge network whose ties identify pairs of people whose names are frequently mentioned together on the same web pages.

Mining coincidences

With regards to time and space, there are four different ways to define coincidence: *basic*, when neither time nor space is considered; *temporal* and *spatial*, when only time or space is considered respectively; and *spatiotemporal* when both time and space are considered together.

Basic coincidence is mined from a database of discrete instances within which a few items co-occur. A major amount of work on this type of coincidence is association rule learning [7]. For a given set of items $I=\{i_1,...,i_n\}$ and given set of transactions $D=\{t_1,...,t_n\}$ when any transaction t in D has an unique transaction id and contains a subset of items in I. A rule is defined as an implication $X \Rightarrow Y$ where $X, Y \subseteq I$ and $X \cap Y = \emptyset$. The simple example is a rule $\{butter, bread\} \Rightarrow \{milk\}$ meaning if customers of a supermarket buys bread and butter they buy milk as well.

Temporal coincidence does not assume that the data already has clearly-defined transactions. Instead every tuple (t, i) is an item i happened at time t. In the simplest case, two tuples (t_1, i_1) and (t_2, i_2) support an itemset (i_1, i_2) if $|t_1 - t_2| \leq \delta$, for a given interval bound δ.

Spatial coincidence assumes co-location. Given the variety of spatial models, the notion of being co-located depends on the specific definition of space, from adjacent nodes in a graph space to items enclosed within a distance radius in a Euclidean space, but commonly captures the sense of being close by or neighboring. Another variation for affiliation network arises from how to define transaction-like instances over space. One way is to specify a group as a reference

feature (e.g., a lake), and treat each instance of that feature (and its neighboring items) as a transaction [8]. Another way is to materialize transactions wherever neighboring items are found, but constrain the multiplicity of the same item in many transactions [9].

Spatiotemporal coincidence deals with tuples with both space and time components. Despite the variability of spatial and temporal coincidences leading to the guess that there will be many ways to define spatiotemporal coincidences, current works in the area mainly focus on the time series approach. Spatiotemporal data is treated as a collection of time series of each item's where being over time. Using time series similarity measures such as Euclidean [10] or LCSS [11] distance functions, the distance between two time series is evaluated. If it is below a certain threshold, the time series are considered similar enough, and the corresponding items are deemed to be co-occurring.

Mining affiliation network from events

Just as an instance of co-occurring items is given the special term transaction in association rules, an instance of co-occurring actors is termed an event or group in social graph terms. The work on inferring an association between actors through their participation in events is grounded in the affiliation network [12]. An event is any social collectivity of several actors, including conferences, games, social events, or meetings. An actor's affiliation to an event, by registration or attendance, establishes an actor-event link between the actor and the event.

By its act of bringing actors together, an event serves as conduit for resource transfer, or simply as a basis for interaction to take place. For example, conferences gather academicians around the world to exchange knowledge and build contacts. Linkages established through events can be interpreted in two ways. Firstly, in case of social graph an event enhances pairwise interactions between its members, in which case an event with n members gives rise to $n(n-1)/2$ actor-actor links.

The second interpretation, in affiliation networks, treats each event as a node of second type with links to all of its n members.

Taking the first interpretation, which is more synchronous with most works in social graph, an actor-actor tie between a pair of actors is said to exist if there is at least one event that the two actors are both affiliated to. Moreover, the number of such events can be taken as the weight of the tie. The collection of all such ties make up the social graph.

Conclusion

In this work the problem of mining social network from spatiotemporal data was introduced. There are several directions for future works. At first, implementation of natural language processing to parse the data from human-readable texts will supply a number of data for mining actors and ties. Second, faster algorithms capable dealing with Big Data approach may boost the quantity and quality of events. Additionally, application of machine learning algorithms would provide better rule detections based on existing data.

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PRINCIPLES OF CREATING RELIABILITY SCHEMES FOR ELECTRIC AND MECHANIC SYSTEMS

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This article is about creating reliability schemes with electronic and mechanical parts' reliability factors are considered. Obstacles of this method is described with simple example of reliability factors' estimation and result's comparison.

Keywords: reliability, reliability scheme, mechanical system, reliability estimation methods.

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When dependability of different radio and electronic devices is estimated, mechanical parts don't be considered, such as soldering, welding, screws, stubs, seals, gaskets, shafts e.t.c. Today there is point of view that dependability of these parts is so good, that no need to consider them for summary estimation because there isn't statistic data of mechanical parts' failures. But dependability of electromechanical systems depends on dependability their parts, interconnections of these parts, relationship of their reliability factors and extreme conditions (see Figure 1) [1].

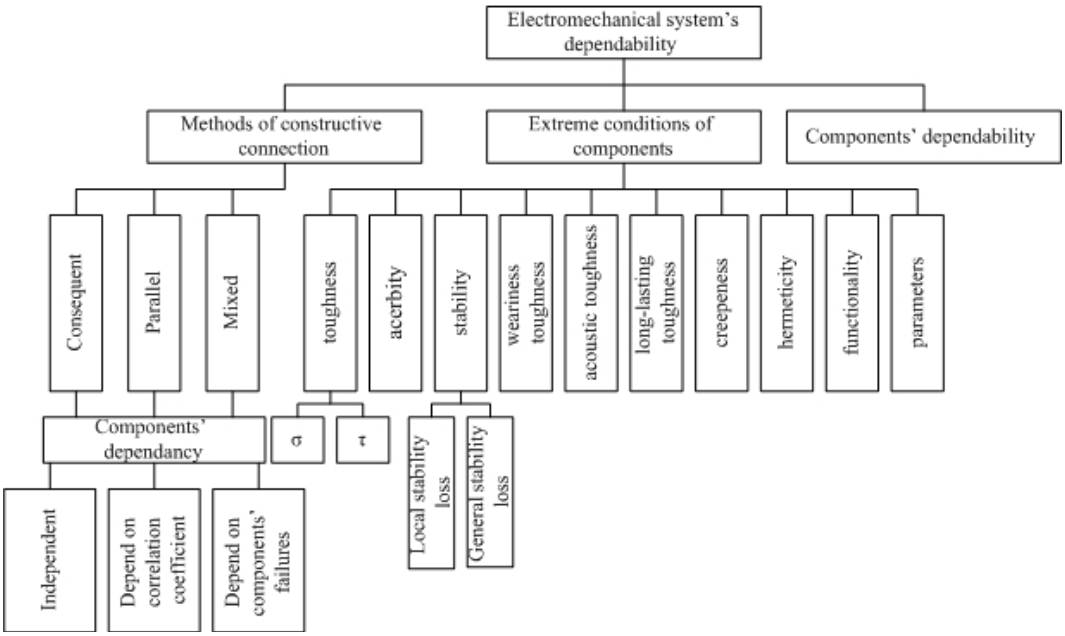

Figure 1 – Electromechanical systems' dependability dependency

Mechanical parts of electromechanical systems may be dependability independent and depend on correlation coefficients at the same time.

Dependability electromechanical systems' parts depends on correlation coefficients if correlation functions aren't equal zero ($r_{x1x2}(t_1,t_2) \neq 0$ or $r_{y1y2}(t_1,t_2) \neq 0$) or correlation coefficients aren't equal zero ($r_{x1x2} \neq 0$ or $r_{y1y2} \neq 0$). It is possible when composition of two system components' random functions (random values) contains same random process (values).

There is dependency on components' failures, when failed part's load (work) is divided among rest of working parts and dependability factors are deteriorated. This dependency is observed not only for parallel parts connection, but consequent too. It is significant that dependency may be on correlation coefficient and on components' failures at the same time.

Estimation methods for dependability mechanical parts are considered in treatises of Bolotin V.V.[2], Tchirkov V.P.[3], Selikhov A.F., Tchizhov V.M.[4] and others. It is necessary to have statistic data of mechanical parts' failures and special referenced data of materials for applying these methods. Two reference books are well-known: published by ICS RAS [7, 8] and NSWC-11 [5]. There is problem of actuality of statistic data because of growth rate of technology and changing of material properties.

Assuming, reliability schemes are represented as set of mechanical and electric parts (see Figure 2). There isn't electric and mechanical parts' failures interference at such presentation of schemes. Mechanism of this interference is complicated and its consideration needs solving of parametric differential equations. But there isn't opportunity to prove necessity of dependent failures' consideration because it's extremely difficult to identify them. That's why it's offered to use introduced reliability scheme for electromechanical system.

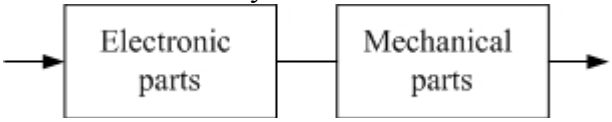

Figure 2 – Electromechanical system's reliability scheme

For example VGA connector is considered. It consists of two connectors and screws (see Figure 3). Reliability scheme of this connector is consequent connection of three components in accordance to GOST 27.002-89 [6] (see Figure 4).

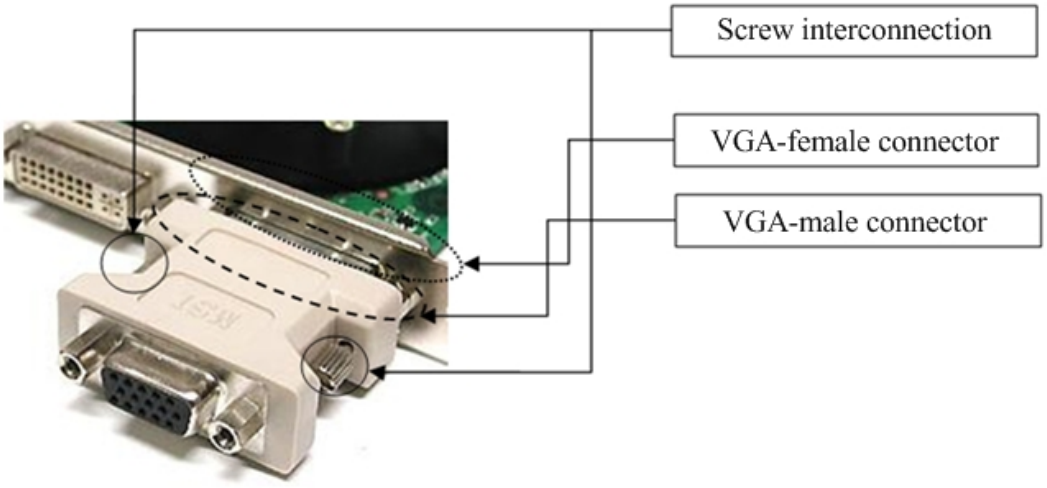

Figure 3 – VGA connector

Estimation of VGA connector components' reliability factors was made using software package ASONIKA-K. Results are shown in Table 1. Reliability function of VGA connector according to components' estimated reliability factors is calculated by following equation:

$$P_{VGA}(t) = P_{VGA-m}(t) \cdot P_{VGA-f}(t) \cdot P_{screw}(t) \quad (1)$$

where $P_{VGA-m}(t)$ - reliability function of VGA-male connector; $P_{VGA-f}(t)$ - reliability function of VGA-female connector; $P_{screw}(t)$ - reliability function of screw connection.

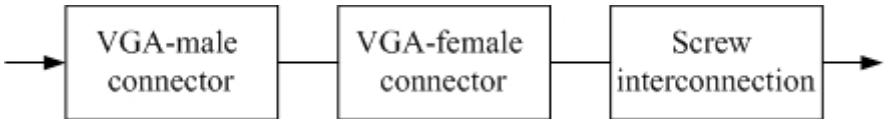

Figure 4 – Reliability scheme of VGA connector

Failure rate of mechanical part (screw connection) is almost equal to electronic parts' failure rate as shown on Figure 5, where results of reliability factors estimation of VGA connector components are represented. This fact is confirmed of failure's rate quantitative estimation, i.e. components' failure rate has the same order.

Table 1 – Reliability factors estimation results for VGA connector's component

Component	Operational failure rate, 1/h	Standby failure rate, 1/h
X1 (VGA-female)	8,00e-08	8,00e-10
X2 (VGA-male)	9,20e-08	9,20e-10
Screw connection	4,10e-08	4,10e-10

Figure 5 – Reliability factors estimation results for VGA connector obtained using software package ASONIKA-K

Electromechanical system's reliability function estimation was realized for continuous work period is equaled to 15 years. Following results are obtained: reliability function for system without mechanical parts is equal 0,977653 and reliability function for system with mechanical parts is equal 0,972399. With regard to requirements to reliability function was given accurate within 3-4 significant digits, we obtained its inflated estimation (see Figure 6).

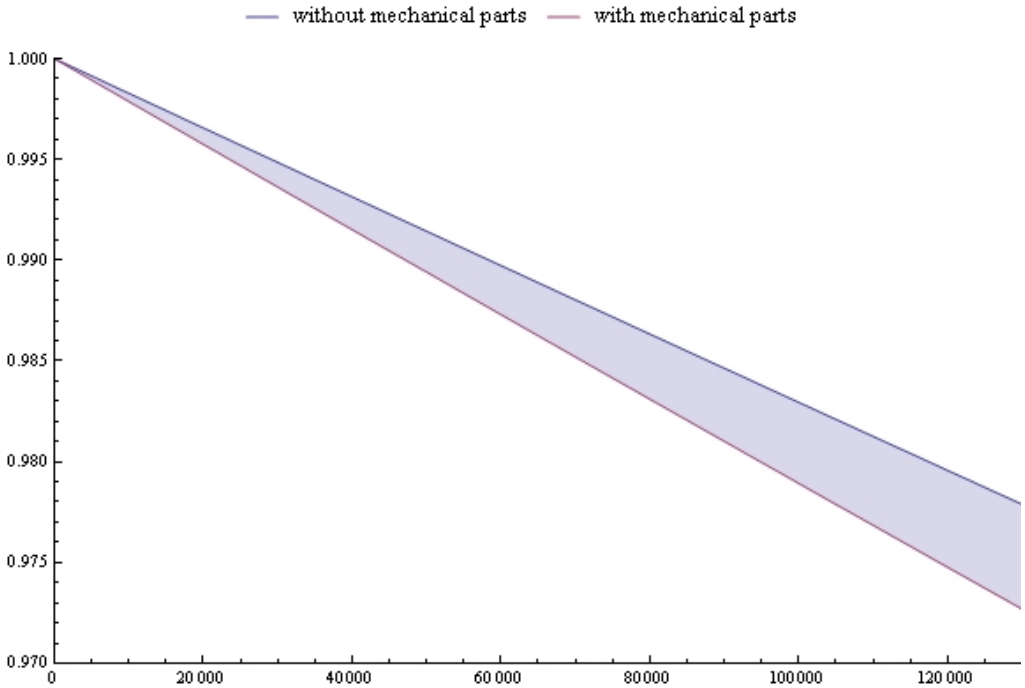

Figure 6 – Reliability function depending on time diagram

Assuming, it's necessary to consider electromechanical system failure as electric and mechanical parts' failure. We obtain more precise reliability factors' values using this method. Meanwhile it's difficult to make conclusion about precise of method because we need more statistic data of failure system, which reliability factors was estimated, and models approbation.

But this method allows considering more failures' cases. In the nearest future correlation function's development and method precise estimating are planned to realize.

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INFORMATION TECHNOLOGIES FOR AIRCREW'S FUNCTIONAL HEALTH STATE ESTIMATION IN REAL TIME

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In this article possibilities of information technologies in aviation medicine applications are considered. Development of hardware-software complex is proposed for remote monitoring and large distance transferring of signals registered on a pilot without quality decrease in real time.

Keywords: information technologies, aircrew, monitoring.

At modern level of the development of information technologies in aviation medicine more and more attention is paid to operators', pilots', traffic controllers' and other people's responsible for complex equipment maintenance health care control. This problem is as important as the problem of equipment control itself because man's mistakes can cause catastrophic emergencies. This problem cannot be solved only with the help of regular medical examination in a specialized medical centre. Pilots and air traffic controllers often work in extreme conditions and their work is very stressful. Thus it is necessary to control their current functional state during their work process.

At present days wide range of special equipment responsible for electrocardiogram control able to remote data transfer and automatic results interpretation in specialized medical centers is developed. However there are no such techniques and resources able to identify early signs of organic lesions or functional blood vessel system, vegetative neural system or central neural system strain in general. As long as flight activity requires constant straining of these systems, the development of adequate techniques and conventional hardware-software control means for the whole aircrew in real time is topical.

For the increasing of functional health state estimation efficiency it is suggested to perform parallel examination of informative parameters of cardiorhythm, breathing rhythm, brain functioning and pulse wave. As long as blood vessel and neural systems interact closely

information, obtained during cooperative processing of these signals allows to authentically identify explicit and hidden impairments.

According to the foresaid we can contingently distinguish ten applications of vegetative parameters processing and analysis techniques that can be used in aviation medicine:

1) Predicting functional health state (organism's stability) during professional selection and determination of professional suitability

2) Functional health state estimation and predicting it's changes in possible extreme conditions, adaptive reaction expression estimation under unfavourable factors of flight activity

3) Functional health state estimation in general and the whole pilot's organism exhaustion

4) Development of prognostic conclusions based on current pilot's functional health state estimation, his blood vessel, vegetative and central neural systems activity

5) Selection of the risk groups in progression of threatening heart rhythm stability

6) Using the technique as a control technique during different functional trials

7) Estimation of efficiency of therapeutic, prophylactic and wellness actions

8) Estimation of stress level, strain level of regulative systems in extreme and subextreme conditions

9) Operator's activity reliability estimation

10) Estimation and prediction of psychic reactions by vegetative background expression

At the present moment on the base of carried researches hardware-software complex for foresaid problems' solving is under development. The complex consists of: hardware-software resources for monitoring and recording basic physiological parameters, these are: pulsogram (PG), galvanic skin reflex (GSR), electro-skin resistivity (ESR), electrocardiogram (ECG) and electroencephalogram (EEG). Moreover it's possible to connect extra modules. With the help of this complex it's reasonable to carry out deeper examination of blood vessel system, neural system on the basis of dynamic estimation and analysis of important vegetative parameters. It is necessary for the further conventional aircrew's workability and reliability estimation in extreme conditions techniques development.

With the help of remote monitoring all data registered on a pilot can be transmitted on a long distance in real time without quality decrease. Such transmission must be realized for a long period of time and the full set of aircrew functional health state data must be available to corresponding medical services of aviation medicine. In all cases monitoring system performs permanent registration, remote transmission, processing and displaying full set of electrophysiological parameters of operator's health state to medical personnel synchronized in time.

All in all these are topicality of remote monitoring task, development of communication resources, their availability and wide spreading that make new remote aircrew examination and observation technique development and application quite reasonable. As long as cooperative medical measurement information of different kinds consideration allows us to estimate pilot's health state comprehensively and in all aspects and to increase prognostic significance of obtained results.

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COMPARATIVE ANALYSIS FOR HEAT TRANSFER MATHEMATICAL MODELS OF TRANSISTORS ASSEMBLY DESIGNED BY CAE PRODUCTS ASONICA-P AND SOLIDWORKS SIMULATION

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Heat transfer calculation task is one of the most important stages in process of on-board electric equipment founded on module principle [2,3]. When information on geometrical parameters and applicable materials becomes available, the analysis of heat transfer in studied object is possible. The analysis of information acquired in the course of such modeling allows studying the correctness of the design decisions received [8] on the radio electronics design stage [1,4,5].

Using the various types of mathematical modeling programs, it becomes possible to analyze inaccuracy of modeling and adequacy of mathematical model parameters build up for studied object.

The Initial stage of heat transfer simulation is in the border conditions determination for the system under investigation [6,7]. For general assembly was used program ASONIKA-P, supporting definition of surfaces integral temperatures of the assembly and the temperature of objects, participating in conductive heat transfer. The module participated in represented study belongs to transistor assembly, and its presentation in the manner of mathematical FEM models are presented in fig. 1[9,12]. Heat productive transistors are fixed on aluminum construction, which realizes the outflow to heat energy on thermally stabilized base. [10]

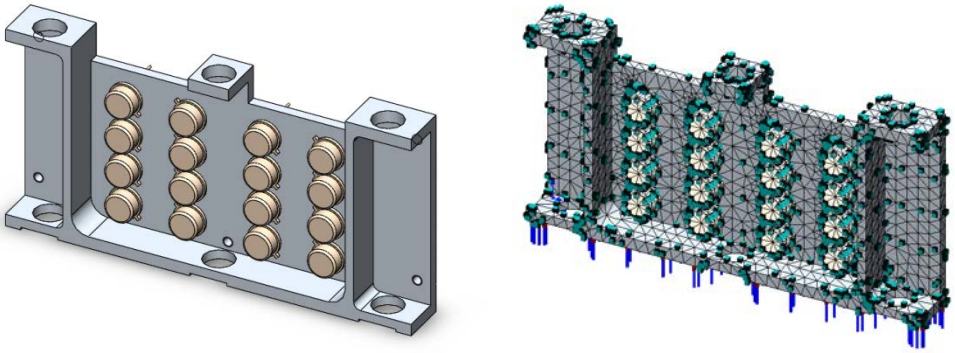

Fig. 1. Models of studied assembly

Its main parameters taken into account at study become: thermal conductivity [11] of the material, type of assembly between aluminum part and thermally stabilized base and the amount of heat energy produced by transistors.

Integral temperatures received with ASONIKA-P for aluminum part and transistors represented in fig. 2 and tab. 1.

Fig 2. Integral temperature data acquired with ASONICA-P

Tab.1. Thermal data

№ model part	Integral temperature, °C	Description
1	52,01	Transistors
2	45,91	Aluminum assembly
3	40	Thermally stabilized base
4	55	Surround

For the detailed analysis it is considered to use FEM CAE SolidWorks Simulation. The output information about thermal parameters of assembly is represented in fig.3.

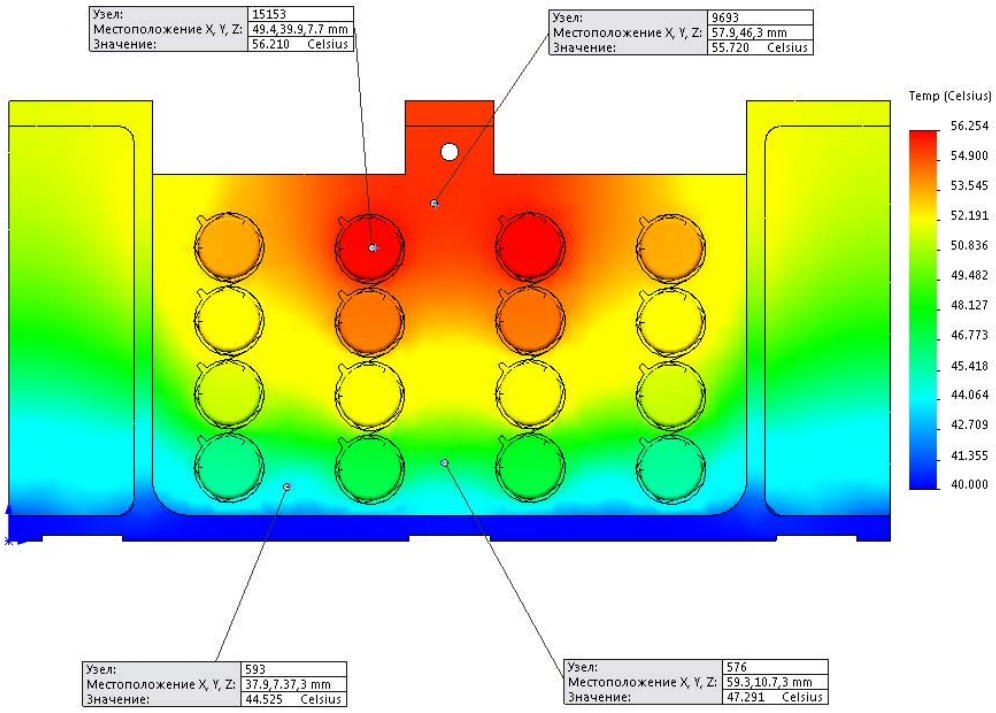

Fig 3. FEM simulation data of heat transfer for studied assembly

The difference between acquired data shows that for mathematical model of the heat processes verification of the border conditions is required to account the extended analysis input parameter for system with correction results of detailed FEM mathematical modeling.

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PROGRAM «ROC-CONSTRUCTOR» FOR ROC-ANALYSIS APPLICATION IN MEDICAL TESTS

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This article is about the program «ROC-constructor». The program is designed to demonstrate the ROC-analysis of the test. User enters the distribution of patients with pathology and healthy patients of any parameter (for example, the concentration of the hormone, blood pressure) and the split point (by test results all patients on the one side are considered healthy, and on the other - sick). The program builds ROC-curve of the test, and for the selected point shows the sensitivity, specificity, and gives the simplest conclusion which side of the partition is likely pathology, or that the test is uninformative.

Keywords: Program, ROC-analysis, education

One of the most important segments of diagnostic is a medical laboratory test. The quality criteria of such tests can be divided into three main categories:

• medical (clinical value of tests);

• analytical (statistical value of tests);

• technical and economic.

Analytical quality indicators are used mainly in cases of poor reproducibility and accuracy of the results. Development of computer hardware and improvement of the quality of laboratory equipment has significantly increased the analytical quality criterion of tests. In this regard, now the medical quality criteria are becoming increasingly important. And the main of them are:

• sensitivity of test shows the proportion (percentage) of true positives among all persons with studying pathology;

• specificity of test shows the proportion (percentage) of persons without studying pathology (healthy), whose test results were negative;

• diagnostic (predictive) importance of a positive test, which sets by the ratio of the number of received true positives to the total number of positive results;

• diagnostic (predictive) importance of a negative test, which sets by the ratio of the number of received true negatives to the total number of negative results;

• diagnostic efficiency (significance) of test is determined by the proportion of true negatives and true positives among all patients.

The using of a method known as ROC-analysis (Receiver Operator Characteristic) is perspective. The purpose of this analysis is the construction of a so-called ROC-curve, which

is most often used to present the results of binary classification in machine learning . ROC-curve shows the relationship between the number of correctly classified positives and the number of incorrectly classified negatives.

Program «ROC-constructor» suits well for teaching younger students and for demonstration of the possibilities of application of computer technology as a Decision Support System or as an increaser of test effectiveness.

It allows to assess dependence between the specifity and sensitivity on the plot. It shows us the real effectiveness of that test at a specific point. Evaluation of sensitivity and specificity is important in choosing a test for using it certain clinical purposes. Sensitivity of the test reflects the likelihood of a positive result in the presence of «pathology». The high sensitivity of the test allows to identify diseased from the total number of patients. Specificity of the test represents the probability of the negative result in the absence of a disease. Provided high specificity it allows to bolt out healthy patients from the total number of patients with suspected pathology. The combination of clinical sensitivity and clinical specificity of the test characterizes the clinical efficacy of the test.

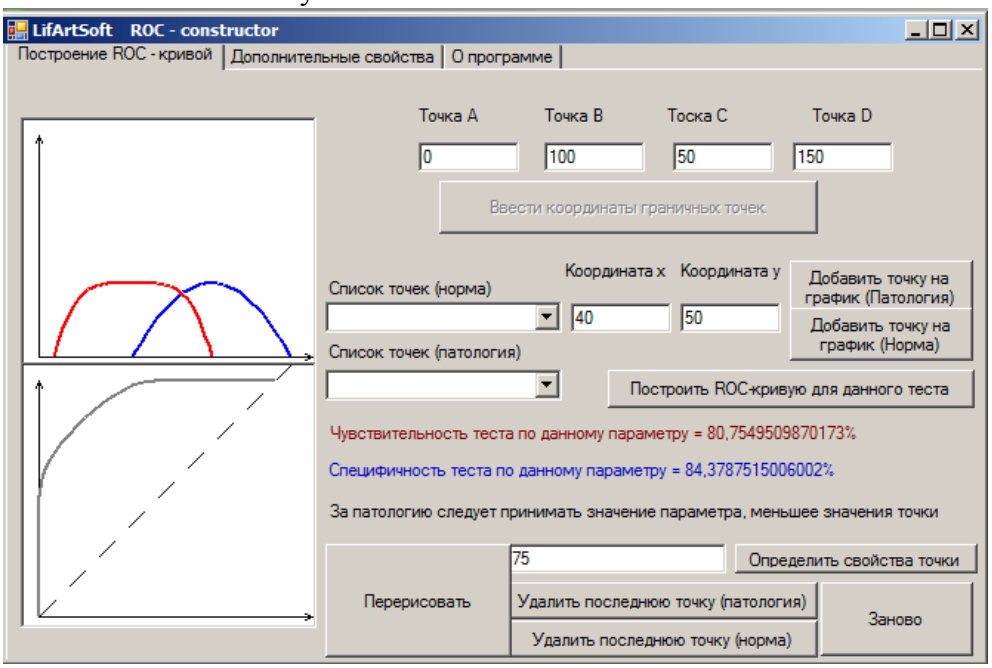

Figure 1

Mathematical principle of working and instructions of using the program:

First, the user must enter the borders of distribution of patients with and without pathology.

A - the starting point of the distribution of patients with pathology.

B - the ending point of the distribution of patients with pathology.

(Value of A must not exceed the value of B)

C - starting point of the distribution of patients with pathology.

D – ending point of the distribution of patients with pathology.

(Value of D must be greater than C)

Then the user should add points to the experimental (expected) number of patients with and without pathology.

x - the parameter value.

y - the number of patients with parameter x.

Program can be downloaded from http://my-files.ru/70ep2p.

Note. Desired ratio between sensitivity and specificity of the test is achieved by choosing the split point. If the ROC-curve is below the median line d, the «pathology» is to the left , and "normal" on the right, as well as the value of the abscissa and ordinate (1- specificity and sensitivity, respectively) will be changed, but the test results won't lose their value.

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DATA PREPARATION FOR RESEARCH ON ENERGY EFFICIENCY OF BUILDINGS

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Data management plays an essential role in modern information systems. Company employed data scientists spend up to 80% of their time on data preparation for each research project. This fact dramatically increase costs of overall projects. This paper discusses a method to reduce time of data preparation for energy management.

Authors created a concept of data collection system for energy management which: 1) collects data from different sources 2) provide estimation of data quality, and 3) prepares and exports data for different purposes (e.g. decision support in energy management, real-time machine learning).

Papers shows two possible practical solutions where data collector will be used: 1) automated estimation of data quality 1) automated data exports, 3) real-time data visualization.

Keywords: data quality, information fusion, data management, energy management, energy

Introduction

Nowadays almost every public building is equipped with a Building (Energy) Management System (B(E)MS) which uses telemetry to measure data and information about processes in buildings, store historical information and visualize them to improve energy efficiency a building. The final purpose of BEMS is automate the functions of the building (HVAC, elevators, access, …). The data can be collected and be used for decision making processes (as much as possible automated) such as benchmarking or building performance or implementing in real-time machine learning applications [1-3].

The analysis of the data will be interesting for companies-developers of BEMS systems as well it customers because their analytics based on data which can automatically alert abnormal energy consumption and data leakages, introduce more energy efficient control algorithms, but these algorithms needs relatively high quality of data.

Contribution of the paper is creation of data collection system of energy data which: 1) Collects it from different sources 2) Provides rough estimation of its quality, 3) Prepares and exports data for different purposes (e.g. decision making processes, model predictive control, and supervisory control).

1. Background

Development of sensor technologies unlocked possibility to generate data from many

measurements. There is need for platforms to publish and share this sensor data in an easy way and to reduce the cost and complexity of sensor data access. Network and internet technology makes it possible to improve control algorithms of a lot technical system using not only local measurement data but also integrate it with remote devices and information of different kind. For instance using weather forecast in heating, ventilation, air conditioning and cooling (HVAC) system of buildings helps to reduce annual energy bill up to 30% [4].

Real-Time data from sensors is another source of information, which can be used to make decisions in various domains. It helps to design better control algorithms and improve performance of various technical systems [5]. Unfortunately, most of such data is locked by specific applications and only accessible within organizational boundaries. Filling the gap, several research institutions are working on solutions by creating their own data stream management systems. In the meanwhile, all research data streams are prepared manually which takes a lot of time for researchers before even experiments can start. Creation and usage of data collection system will 1) reduce time for preparation of appropriate data; 2) provide information for data mashups which combines content and representation in one interface; 3) integrate data and knowledge into real-time decision making systems.

Moreover, the development of data technologies forced research groups and scientific organizations around the globe to develop solutions for data management.

There are several tools for extraction and transformation of data such as Oracle Warehouse builder, Data services, IBM Information server etc (see the full list[8]). Machine to machine communication protocols such as MQTT and enterprise service busses MSMQ, ZeroMQ and RabbitMQ simplified communication among measurement devices and high level programming language. Frameworks of complex event processing (such as Microsoft StreamInsight, yahoo pipes, spark streaming) enabled possibilities easily control data on the fly. NoSQL databases (such as RavenDB, MongoDB) are specially optimized for huge amounts of data. Tools for statistical data analysis such as R, Matlab, Octave (and 100+ others) are developed to perform statistical analysis of existing data. In addition, there are a lot of online data mining frameworks recently developed (eg. Mahout and Scipy).Web data visualization tools such as d3js, highcharts made possible to represent data for user in a convenient way. High-availability distributed object-oriented platforms (e.q. Hadoop and HDInsight) and cloud computing (such as Amazon Web Services, Microsoft Azure) makes data platforms easily scalable.

The most difficult issue is that all data sources are in different places and in different formats. There is no tool which can rapidly estimate the data quality, so we can hardly speak of implementation of real-time machine learning algorithms on it.

The goal of this paper is to create a solution which helps to structure data useful for the energy domain to reduce time of analysis by automation of data preparation and creating new solutions based on this data for energy management.

2. System Concept

Data need to be collected from different sources to be fused and used for different purposes of higher-level applications. To match these goals, the solution (further data collector) should be able to match certain criteria:

1) Accept machine generated data (click-streams, sensor-generated data etc) as well human generated data (properties of objects, generated manually, results of polls etc). Integration of new sources should be as easy as possible.

2) Data needs to be stored as much source independent as possible. Data can be extracted, combined and transformed from original resource on demand or preprocessed.

4) System needs to provide user-readable overview about quality of data which will let users understand the quality of the collected data in the system. Context-aware data quality will be checked on the application on top of it.

Solution need to have an easy interface to provide data for different purposes: 1) to show it in real-time, 2) extract data into selected format for further data analysis, 3) use for real-time applications such as smarterdam [6].

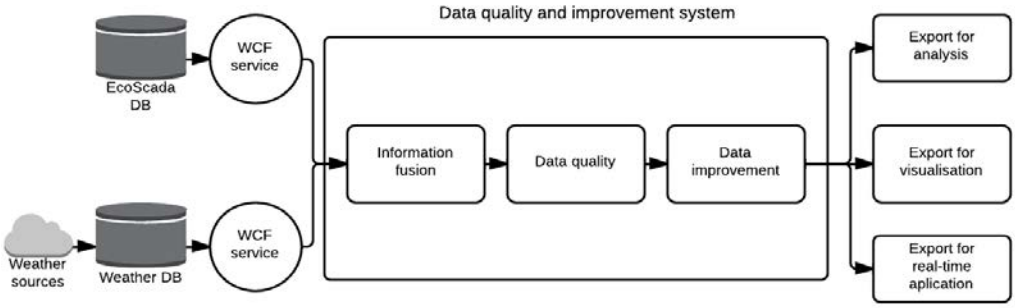

Figure 1 - Architecture of data quality and improvement system

The solution can be divided in the following parts: 1) external web-services, 2) information fusion system, 3) data quality and improvement system, 3) data export for further analysis and data visualization.

2.1 External web-services

Currently data collector obtains data from two types of data sources: 1) Building Energy Management System EcoSCADA (energy consumption, temperature data and occupancy patterns), 2) data from weather forecast from different sources (eg. Norwegian Meteorological Station [7], Wunderground meteorological service [8]). All the data in the database must be saved in UTC format.

All data is saved in machine-readable format generated by filehelper framework which seriously reduce time for information export and import. The original data is saved into files in case it may be needed later.

EcoSCADA collects and stores data in their original format: 1) pulse counters, 2) meter readings, different weather services describes weather by different parameters and in different units. The purpose of the exporter of EcoSCADA (WCF service) is to bring values into one common format of international system of units to have data on good scientific level.

Value format conversion table is developed to create common scientifically accepted format of all building energy data collected to perform the research on scientifically accepted level.

2.2 Data quality and improvement system

Authors split quality into two parts: 1) basic data quality; 2) context-aware quality (data quality for special algorithms).

There are several basic checks which are important to be implemented to make get an insight into the data quality for a certain building from the selected period: 1) accuracy, 2) timeliness, 3) stationary, 4) correlation. Based on these characteristics data are improved by different algorithms of data process: gap filling, outliers detection, etc.

Data are to be exported for three reasons: 1) export for analysis in analytical software (R, python, Mathlab, Deductor Studio, etc.), 2) use for data visualization, 3) real-time decision making.

In case (1), the main function of the system is to export data from the in a format ready to be used in commonly accepted analytical software. It is created to identify not vivid relations in data, support theoretical models and prepare algorithms for real-time usage. Data preparation process is represented on Figure 2.

All received measurements needs to be converted to common formats (Values are converted to international system of units, text values to commonly accepted formats such as METAR, conversion of meter values). All data are converted from local time to UTC.

All exported values from all measurements are made equidistant, gaps are imputated.

Stage 12 on the diagram improves data by values imputation and gap-filling and filtering outliers. System interpolates missing values using average algorithm:

$$x_i = \frac{x_1 \cdot (n - d_1)}{n} - \frac{x_2 \cdot (n - d_2)}{n} \quad (1)$$

According to Chebyshev theorem, for normal distribution, 99.7 observations fall within 3 standard deviations of the mean μ. Due to the fact that the distribution might be different from normal we used the following formula to filter out outliers:

$$|M(x) + 3 * \sigma + n| < 0,973 \quad (2)$$

Based on formula (2) system filters out the highest and the lowest 0.27 percent of the set.

System is written in C# on Microsoft Visual Studio 2012 with .Net Framework 4.5. Databases were implemented in SQL Management Studio 2012.

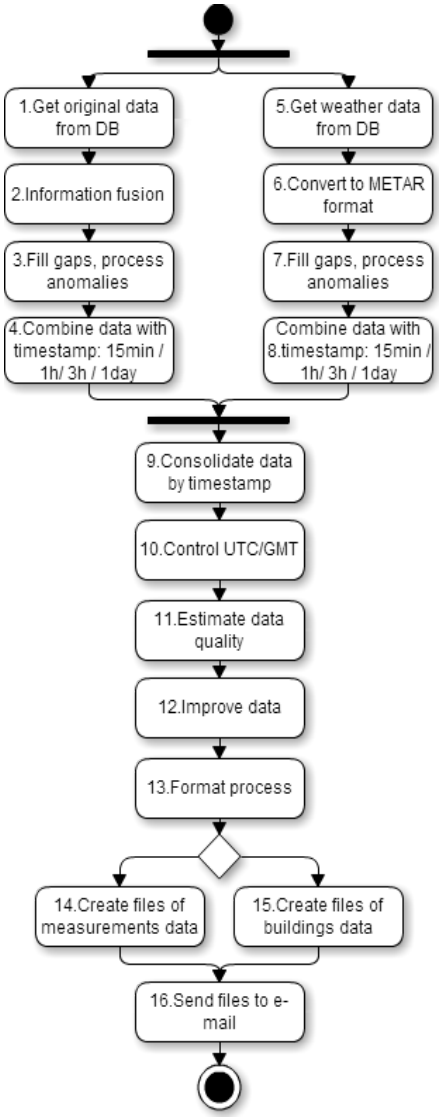

Figure 2 - Data preparation process

3. Case studies

Authors implemented web-based interface to export data from building measurements. It is represented on Figure 3.

The Interface gives possibility to export all values measured in a building and degree-days in one file (1) and each measurement in separate files (2).

When all the measurements of the buildings are selected, analyst chooses time interval for data export, data resolution (may be 15 minutes, 1 hour, 3 hours and 1 day, 1 month, 1 year), export mode (all measurements in one file or each measurement in one file).

Moreover, system has an option to make format consistent with analytical applications (such as Weka and R) by setting up delimiters.

After all settings are finished, files will be sent to email of the researcher.

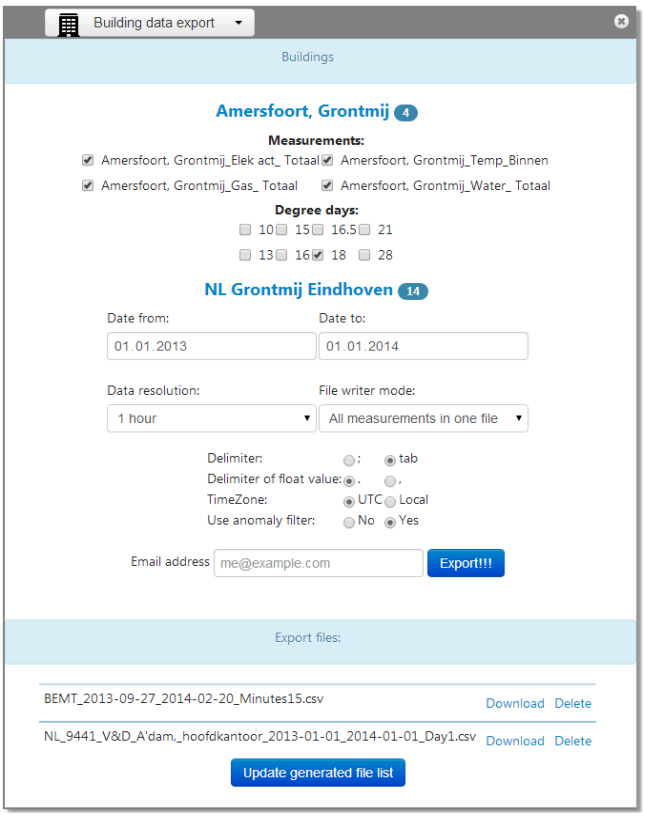

Figure 3 - System web-interface

3.1 Data export formats

In "detailed export mode" file contains full description on exported measurement (Country, City, BuildingName, TimeStamp, Values, values types, Flag of trusted values, TimeShift in hours). This method is dedicated for manual data quality evaluation and preparation to be exported to Hadoop or other data export. Authors implemented trusted value field to track originality of values. It is triggered on true when system did not apply any conversion on data (whether scale has been changed or data was automatically imputated).

All values in export mode contains all data in one file prepared to be to be consumed in statistical packages (such as R, Statistica Octave etc).

4. Results

Authors created data collection system which performs data fusion from different data sources (such building energy and weather data), which fetches data from external data, performs information fusion, evaluates quality of arrived data.

Data collection system provides web-api which can be used to export data into the files, and used in data visualization applications.

Developed system allows researchers to skip data preparation phase and start with research on data.

5. Acknowledgement

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DIGITAL SIGNAGE AS EFFECTIVE TOOL OF ENERGY MANAGEMENT

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According to experts, depending on the power management policy can achieve substantial savings within 5 – 30%. For this purpose, large number of software systems and methods were developed to simplify energy management in buildings. In this paper, we propose new set of tools to assist managers to perform more efficient energy management.

Keywords: energy dashboards, public building, digital signage, solar plant, digital signage, BEMS, energy profiles.

1. Introduction

Today, the EU applies accepted in 2007 the program "20-20-20" or so-called directive Energy Efficiency Directive, one element of which is to reduce energy consumption in the region by 20% by 2020 through energy-saving measures. Directive is considering very important problem, it announces priority saving modernization of buildings. According to the Building Performance Institute Europe (BPIE) [1], the communal sector accounts for 40% of energy consumption in Europe and 36% of CO2 emissions. Directive recommends annual energy-saving modernization of at least 3% of the buildings of more than 500 square meters, owned by the state.

The implementation of this program is by the introduction of new technologies and the creation of innovative materials and equipment, the production of which will enrich the European companies. The European Commission estimates, the goals of the "20-20-20" in terms of energy savings will provide the appearance of 2 million new jobs and essential cost savings per year per household costs due to lower electricity costs.

Energy saving measures are expensive and have a long payback period, as the cost and installation of energy-saving equipment is large enough. In connection with this is an actual

problem of the proper planning and management of resource consumption.

The main problem, according to experts, is not knowledge homeowners how to save the resources they consume. This is a problem with the wrong or not a convenient way of presenting information. For example, accounts for the consumption of gas and electricity is stored in the form of bills on paper, respectively complicates the understanding and analysis of this information.

In connection with this very urgent is the development of dashboards that allow for the user in an understandable form to visualize all the necessary information.

The contribution of this work directed at attracting attention to the problems of consumption and saving resources by using digital signage.

2. Backgrounds

Increase of energy efficiency is primarily a human-related task needing user centered approaches for being tackled [2,3]. Different kinds of feedbacks can be used and they either can induce actions or be completely ignored depending on many factors including users green attitude, visual appearance, understandability of exposed information, etc. Among investigated mechanisms and visual solutions, the research community has currently reached a partial consensus on a set of basic interactions that are generally successful in promoting reductions in energy consumption. These solutions include:

1) Goal setting interfaces, i.e., interfaces based on users desire of fulfilling a given objectives;

2) Direct feedback on not effective processes in the building;

3) Historical trends in consumption;

4) Energy consumption benchmarking.

Analysis of the literature shows that there are several good solutions to increase the efficiency of energy use. The first way is to replace all the old and not effective equipment to newer. As a very simple example is the replacement of light bulbs with the filament or mercury lamps to LED light bulbs, etc.

This way allows achieving very good results and, depending on the modernized equipment, savings can reach 50-70% (for example, light bulbs). The disadvantages of these solutions include high dismantling work, design, purchasing and installing new equipment. In addition, the payback period may be several years or more.

The second most promising way, allowing get instant results in the form of saving resources without the payback period, the change of behavior of consumption.

In confirmation of these assumptions was created research under the leadership of AC Menezes, A. Cripps among managers of large office buildings, which manages of power supply policy. Research among the many office buildings showed in most cases the main consumption resources are not on working time (56%) and only 44% are in working hours [4,5]. This is mainly due with the high proportion of negligence and cynicism among staff that leaving the building is not turning off the lights and various equipment. In addition, a study was conducted at night, which assessed power status office equipment, and computers working after hours, the results of which revealed that the range of the number equipment that has not been turned off varies greatly from 5% to 67% [6, 7].

Consequent strategies typically include 3 widely agreed approaches:

1) Feedback;

2) Reward;

3) Criticism.

Feedback shows residents how much energy they use; it can assume different forms and it must be easy to understand and immediate in its effects, i.e., users shall be enabled to immediately relate provided (visual) information with the corresponding setup in a building. Reward consists in providing users rewards (monetary or social) for their good behavior

towards energy consumption. Finally, criticism is based on the idea of confronting users with surrounding people, passing judgments on them that depend on how well they save energy. This last mechanism proved to be rather unstable in its effects with many studies providing contrasting results.

All three of these strategies can be easily implemented on the basis of digital signage. For example, as a reward or criticism that can be implemented in a visual tool for the user show how much money he saved or spent for a specified period of time in comparison with other users.

Our main objective is to create a special digital information platform with the ability to quickly and easily create new tools that enable you to display data for the current and total energy consumption in real-time or historical data for a specific period.

3. Solution concept

Based on scientific studies, customer surveys and practical experience with EcoSCADA the following requirements need to be fulfilled: application should be platform independent, need to be easily integrated with services freely available on internet and must be adaptable over time. Moreover, it is important to use machine-learning algorithms in real-time [5]. The architecture of proposed solution is shown on figure 1.

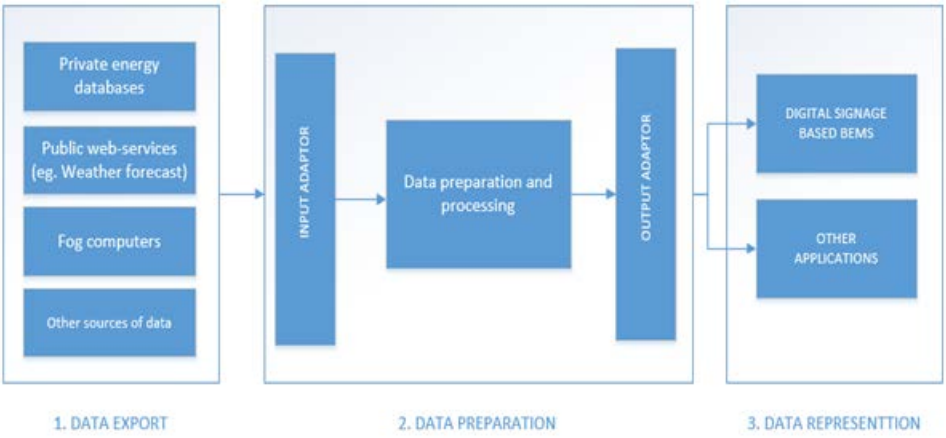

Figure 1. System architecture

The solution consists of three layers:

1) Data Export. That can be any of publicly available data sources list of data sources which can be any of available resources, providing weather forecast (for e.g. weather forecast from www.no.ry, Swiss meteorological institute etc), data from computers in a fog [6], data from other public services and databases. In this research we used mainly data from EcoSCADA as basis but also it is possible to use any other source of energy data.

2) Data preparation and processing is needed only if case if gadget combine data from several separated sources or apply machine learning algorithms in real-time. If gadgets doesn't need to have any additional data management, this stage can be skipped.

3) Representation of data, which is consistent with the platform and a number of gadgets.

4. Gadgets

Gadgets are tools, which can be, realized separately from the digital signage platform and represent (energy) data in combination with other gadgets in the way it brings value to users. Gadgets are created to provide accurate information in real-time to inform and entertain users.

In general, gadgets can be setup to show information from different data sources, which may be weather (historical, real-time and forecast) data and any other sources (e.g. solar

radiation, traffic jam etc.).

Each gadgets will have predefined set of data and it is used to fill the gadget with the information. Any of gadget can inform (maybe in competitive way), provide feedback (e.g. generate advices to people, give reward for energy efficient actions, criticize, act automatically on certain events (for instance model predictive control)).

It can show strategic information (such as historical energy consumption, following up targets etc), tactical (e.g. energy consumption for a day) and operational information.

Also, there is a possible to create gadgets which provides interaction based on real-time data. Interaction may be 1) indirect (ex. temperature rises when enough people entered the building, the lighting shifts differently depending on number of inhabitants in a room), 2) direct (thought sensors or devices in the building that people know where there are in the building).

The process of creating new gadgets consist of the following stages:

1) Defining the purpose and goals of creating gadgets. On this stage it is recommended to ask the following questions: a) What are we going to show?, b) Why do we like to show this?, c) How are we going to show? And d) For who will we show this?

2) Defining data source, examining data quality of the data source. The data source can be an energy data database (e.g. EcoSCADA, weather (forecast) service etc).

3) Defining period to show on dashboard: static information, retrospective (weekly, monthly, yearly), data in real-time, forecasts.

4) Defining interaction rules with end-users: no interaction, direct interaction, indirect interaction.

5) Define purpose of the dashboard: inform, compare (compete), following up targets, generate advices, perform actions automatically.

6) Choose a way of information representation: text, diagrams (line charts and bar charts),

7) Define methods of gamification which can be used to involve more attention of users to a problem. This possibly can be adding levels, virtual rewards, competition between entities, hall of honor.

8) Define KPI to track efficiency of implementing the gadget.

Figures 2-8 represents developed gadgets that use information from the database coming from more than 1000 buildings.

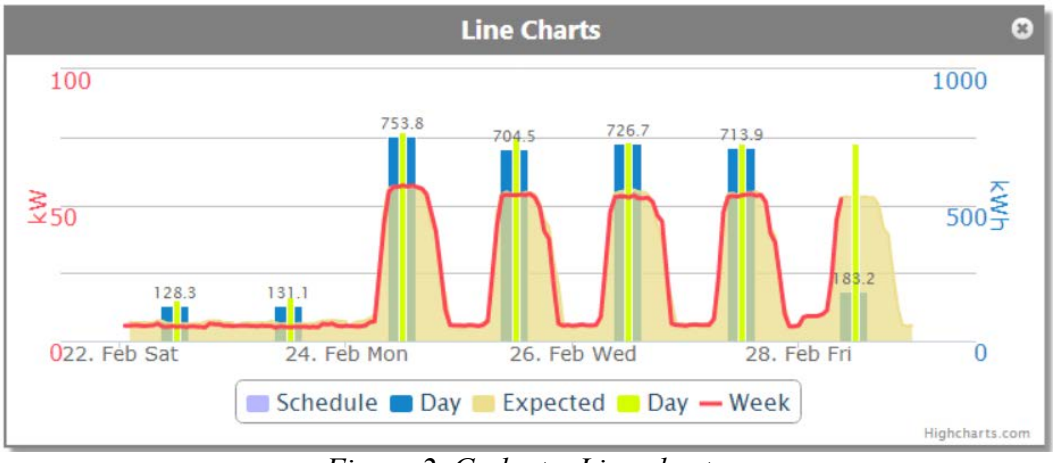

Figure 2. Gadget – Line charts

Figure 2 represents line-chart - energy consumption/energy production on daily basis which shows energy consumption/production in real-time (marked in red), yesterday energy consumption/energy production, and the average value (user can choose: seven last days or average of four the same days of week).

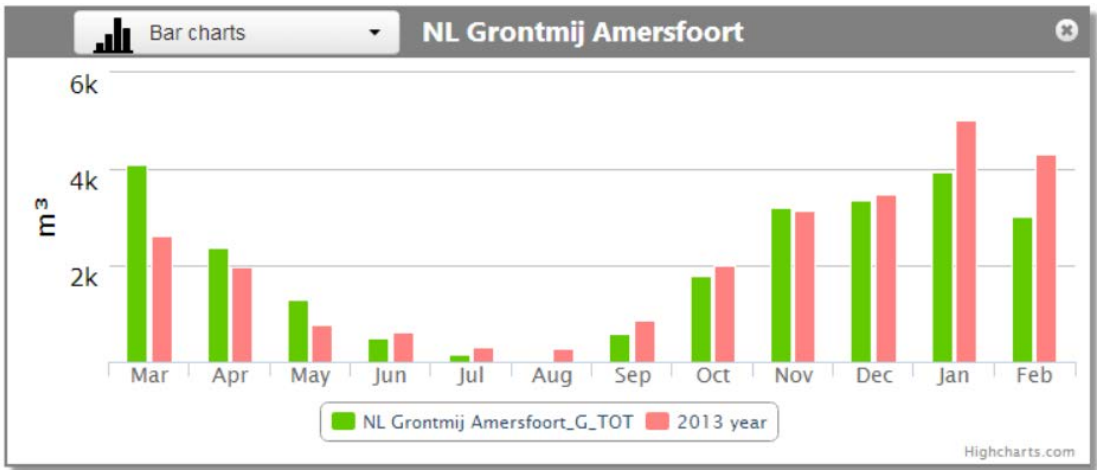

Figure 3. Gadget – Bar charts

Figure 3 shows bar charts which can compare energy consumption for the last 7, 30 days and 12 months between different measurements of the same building, compare day and night energy consumption from the same measurement. This kind of gadget is the most frequently used in data visualization, as it allows for the user in an understandable form to display information such as the amount of gas consumption during the period.

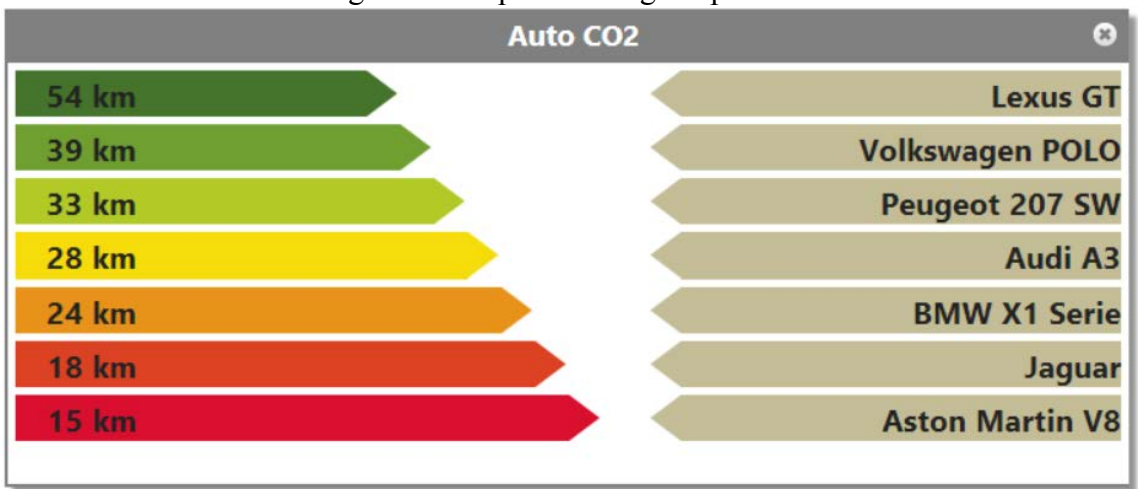

Figure 4. Gadget – Show CO2 reduction in kilometers driven by different cars.

Figure 4 shows CO2 reduction in kilometers driven by different. CO2 reductions in equivalent of kilometers driven by car is calculated by the following formula:

$$\text{total kilometers} = \frac{\text{Energy consumption} * 0.67}{\text{CO2perKm}} \quad (1)$$

Where energy consumption (kWh) total amount of energy saved by installation of solar panels, CO2perKm (g/km) - amount of grams of CO2 exhausted into the atmosphere.

Figure 5. Gadget – Data source map

Figure 5 shows gadget, which was created on base Google maps for monitor working capacity of various kinds of sensors transmitting information. It can effectively solve the problem of fault detection and timely correction of equipment.

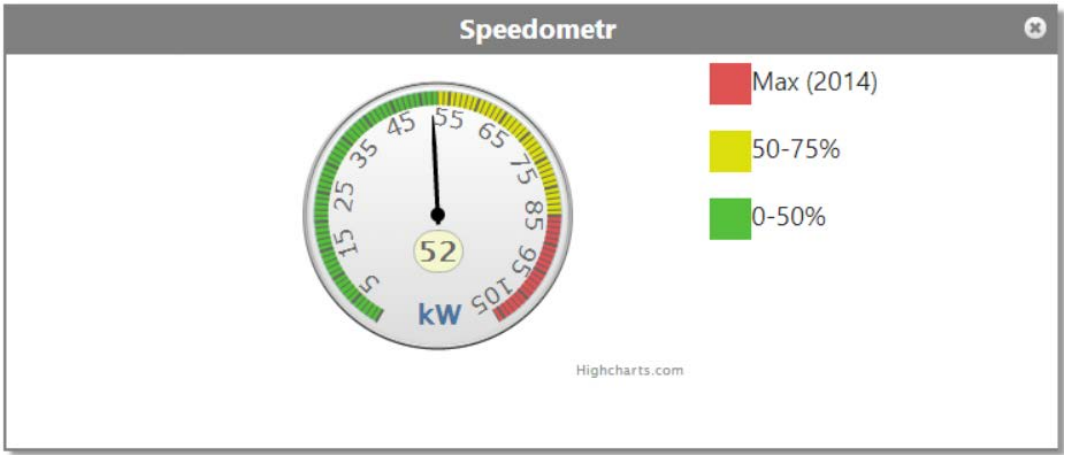

Figure 6. Gadget – Speedometer

This gadget allows quite simply show the current resource consumption (gas, electricity) in the building where color scales are calculated as a percentage of the maximum consumption per year (red bars). Data are updated every 15 minutes.

Figure 7. Gadget – CO2 Reduction

Figure 7 shows saving in CO2 brought by installation of solar panels or changes in energy consumption. It can show CO2 reduction in kg as an absolute value and in percent in comparison with the situation before installation.

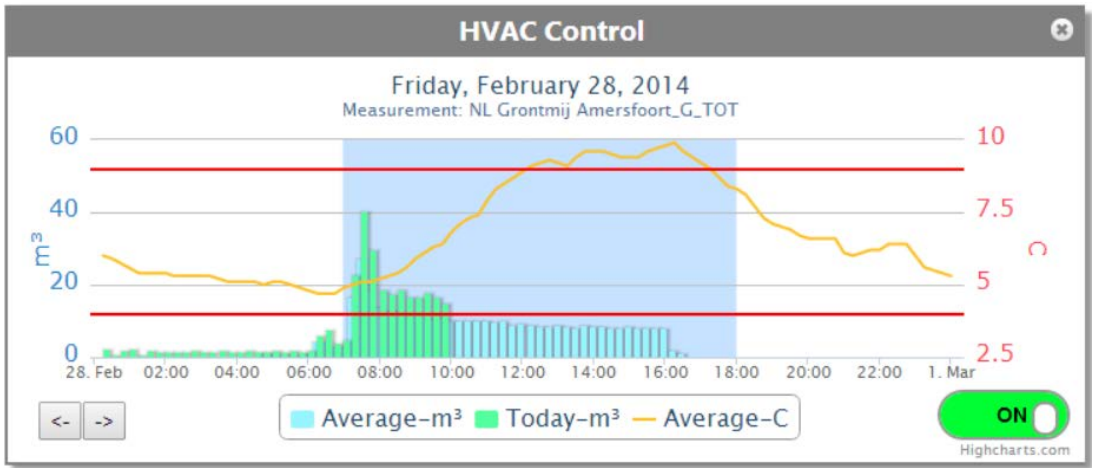

Figure 8. Gadget – HVAC control

In our opinion, the most useful and informative of the developed us of gadgets is to control the heating system. It is a classic bar graph gas consumption (blue columns), the current room temperature (yellow line), minimum and maximum temperature limits (red lines) and the schedule of work of the building (the purple area). So for economy of resources is sufficient to analyze schedule and adjust the heat curve, for example, after working for the building and closing the need significantly decrease gas consumption and keep the room temperature is close to the minimum permissible border.

The solution is developed in C# using the following frameworks: MVC4, highcharts and bootstrap, Html5, javascript, jquery.

5. Conclusions

The authors proposed and developed an information system and number of special gadgets designed to the visualization of large amounts of data on the consumption of resources. The main purpose of the work was to attract attention to the problems of homeowners saving resources.

The concept is realized in program code and implemented in several locations. This solution potentially increase efficiency in building, reduces greenhouse effect.

6. Acknowledgement

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STRONG EM-PULSE DEVICES TESTING RESISTIVITY AND SAFETY TEST METHODS

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Test methods are considered for objects safety and resistivity to strong artificial and natural EMP impact.

Keywords: electromagnetic compatibility, electronic equipment, testing methods.

EM-impact testing methods problem is connected to strong EM emission sources problem.

Successfully solution of this problem is depends on a number of other problems solution, one of that is EM factors emulation in sufficient measure to cause object performance malfunction.

This task is not so easy. It often requires extremely action values, not usual time- and frequency-domain impact performances and all that factors must be represented in huge amount. High quality solution of this problem requires deep scientific investigations and new technical solution search. A number of this researches if field of EM pulse emulation were performed in Russia and USA. The results are presented in [1–3].

The problem of EM fields action and parameters emulation includes wide range of problems and EM-emission sources.

Natural and artificial EM emission sources are: nuclear explosion, lightnings, radars, transmitting systems, RFI from power transmission lines, railways, high voltage setups, ultra-wideband and microwave sources, ESD, EM weapons.

With wide range of EM impact objects, every of that has specific design and functional features under EM pulse (EMP) influence. Consequently, it has specific influence on emulated EM field performances and much more complex object features dependencies and emulated EM field parameters.

Its own test methods are developed for each object individually.

EM field influence parameters representation problem solution can be divided to following branches:

- EMP from various sources parameters representation in local volume;
- impact conditions and parameters representation;
- execution and drafting of test methods standards requirements;

The last branch is highly developed. It is main stage of objects testing.

At present time a new Russian, USA and NATO standards generation is applied. This standards set equipment EM impact resistivity requirements and EM influence test methods. For civil equipment IEC6100 standard series was developed. These standards relates to air nuclear explosion parameters, methods and equipment for testing, measurements and protection. EMP imitators catalog was issued.

However, EM impact clarification requirements researches goes on. It is connected to modern trends of EM weaponary and its carriage, new treats models and impact result, EM resistivity requirements definition methods and EM fields parameters clarification.

Real EM impact resistivity requirements accordance are evaluated mainly by tests using EMP emulators.

EMP representation methods are influenced by parameters, especially by EMP to object interaction physics, standards requirements, that defines objects purpose and function and EM emission. Research results analysis shows, that emulation methods quality influences to object EM safety and resistivity evaluation, also protection methods and tools concept.

One of the main equipment with defined EM resistivity design factors is standards availability, which sets optimum objects classification, technical requirements and test methods and equipment. Those documents include general technical requirements, sate and international standards. The clarification concerns object function division, object environments condition division. There are following objects: ground, naval, air, rocket weapons, spacecrafts.

Each object group has its own features, which are need to be taken into account during EM fields parameters emulation.

Test base appearance depends on such device under test feature, as mobility, transportability. Large dimension immobile test setups with local test volume serves for the first objects under test class. Portable emulator complex serves for second class. It is need to approach to emulated EM field parameters at test zone matching to defined EM field parameters. Defined EM field parameters are parameters defined by test standards and matching to in-place test conditions. If whole object is placed in testing zone and right oriented along EM-filed vector components, then such test is known as direct test. But not always ideal test environments can be provided. Uncertainities can be caused by following:

- test volume dimensions are insufficient for whole device under test placing;
- emulated and required impact parameters (in frequency and time-domain) are not matching;
- device under test and test EM field vector components are not right oriented;
- device under test distorts test EM field. These conditions requires special test methods developing.

Typical example of such test is division of large-dimensioned complex device under test to subdevices and subsystems. Every subsystem is tested individually. Other system are emulated by equivalent sources. At design stage division to blocks and elements is effective. The most vulnearable elements are selected for individual testing. The purpose of this test is search of circuit design methods for real element testing or search of protective methods of system to device under test response to EM radiation.

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CURRENT STATE EVALUATION OF PERSONAL DATA SECURITY ENSURING

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This article is devoted audit stage of personal data security "Data Analysis". The current state of personal data security ensuring is evaluated according to three criteria: the degree of documentation, the degree of implementation, the degree of staff awareness. The evaluation process is showed by the example of the degree calculation of documentation. The research was conducted in combination of expert analysis and computational experiments.

Key words: personal data security, compliance level evaluation, document text characteristic, fuzzy logic controller.

Introduction

The audit of personal data security easier to carry out when there is a single approach to the collection and evaluation of the obtained data. In this article we will look how do it by using the private index system.

The current state evaluation of personal data security is to determine compliance level (L) according to legal requirements. The evaluation criteria are the degree of documentation (d^1), the degree of implementation (d^2), the degree of staff awareness (d^3).

For automatic evaluation process is developed fuzzy logic controller [1,2,3]. The controller includes a user interface, generator of fuzzy production base and fuzzy logical output.

Basic aspects of the approach

Private index system is based on the legal requirements in the field of personal data security. This system has a hierarchical structure. First system level contains seven group index p_i. Each group index of first system level reveals deep and forms own group of private index.

Parameters in the first level p_1, p_2, ..., p_7 determine the focus of assessment. Conformity assessment of personal data protection:

1) the requirements of classification and adequate level of protection personal data;
2) the documentation requirements;
3) the requirements at all stages of the life cycle of PMIS;
4) the requirements for the work of staff;
5) the requirements to the processing of personal data;
6) the requirements for the use of data security facilities;
7) the requirements for access control.

This classification of private index allows to group them by the methods of obtaining evidence at the stage of data collection, by processing at the stage evaluation criteria analysis and calculation.

At the first three evaluation directions should be applied method of obtaining evidence "Documentation Analysis" and calculated the degree of documentation. The degree of documentation is ultimate sought amount.

At the fourth evaluation direction should be applied two methods of obtaining evidence "Documentation Analysis" and "Staff interview". The degree of documentation and the degree of staff awareness are calculated at the stage of audit results analysis, which allow calculate the compliance level of the fourth group index.

At the last three evaluation directions should be applied methods of obtaining evidence. They are "Documentation Analysis", "Staff interview" and "Observation". The degree of documentation, the degree of implementation and the degree of staff awareness are calculated at the stage of audit results analysis. The compliance level is calculated according to these criteria.

Evaluation of the compliance level

Let's consider for clarity 2 major stages of audit: data collection and analysis of received data.

Data collecting. Methods of obtaining evidences are used at the stage: documentation analysis, staff interview and observation.

"Documentation analysis" method for all private indexes. This method is intended for obtaining evidences about auditee's presence and quality of documentation from the field of personal data security. Every private and ultimately group index covers specific area of activity in personal data security ensuring. At the stage of audit initiation it should be determined what documents relating to particular private index will be presented for the audit. Auditor should classify received documents. The names of group and private indexes identify functional area which is covered by these indexes. Let's take a closer look at the documentation of group index p_2. Initially next major groups of documents are distinguished here:

1) organizational and administrative documentation, p_{21};
2) informational personal data system documentation at all stages of the life cycle, p_{22};
3) documentation of personal data technological processing, p_{23}.

The following groups are distinguished at all stages of life circle in informational personal data system documentation:

a) common requirements that cover development organization and approval of project and in line documentations, provided requirements specification, of the created under the control of personal data security system, p_{221};

b) project documentation, in which should be regulate personal data processing, order of installation, setting, exploitation and recovery of necessary hardware and software, p_{222};

c) content of in line documentation, regarding administration processing of informational personal data system, namely act order guide of informational personal data system administrator and staff occupied in personal data processing, p_{223};

d) content of in line documentation to determine act order of staff occupied in personal data processing, p_{224}.

Private index p_{uvs} (in this case - p_{221}, p_{222}, p_{223}, p_{224}) are the end nodes of hierarchical structure of index system. Documents are provided to hierarchy end nodes. Each end node can contain a lot of documents, which auditor must divided into the sets. For example, documentation of private index p_{224} can include such sets of documents as:

- documents of personal data processing in the informational personal data system from the staff department (guides, instructions);
- documents of personal data processing in the informational personal data system from the operation department (guides, instructions) and others.

Depending on the size of the auditee there can be more than one but not more than seven such sets. If the number of sets is more than seven, it is necessary to decompose them further. As a rule every set of documents contains more than one document.

The amount of sets of documents for every private index, the amount of documents in set, their names are input in the fuzzy logic controller and fuzzy productions base is generated.

Every document must be studied and analyzed. Analysis is performed on three criteria:

1) informational content of document's text (ICD);
2) completeness of document's text (CD);
3) formalization of document's text (FD).

In text theory informational content is interpreted broadly as all content of the message, strictly – as new knowledge that is in the text. In this task the term is considered broadly [2]. Under completeness of document's text we understand full/detailed description of all informative units of document's text. During estimation of completeness of document's text formalization of document is checked, whether it suits the requirements or not. Well formalized document highly increases its understanding.

For qualitative evaluation of document's text for each criteria it is necessary to set features of criteria. Features will allow evaluating the studied document more adequately.

It's known that the following main features are inhered to the evaluation of signs demonstration intensity that are usually used by people [1]:

- quality of evaluations, for example, "incorrect", "correct";
- approximate evaluations, for example, "high", "very high";
- use of opposite ratings, bipolar ratings: "fast-slow", "right-not right";
- presence of a neutral evaluation: "average level";
- use of modifier evaluations: "very", "enough", "almost";
- symmetry of the scale of opposite rating: "very slow-very fast".

According to this recommendations scale that displays symptoms for every criteria in interval [-5, +5]. The example of scale is shown in table 1.

Table 1 – The Scale of informational content features of document's text

Scale	Informational content of the document	Mark
-5	Text is completely incomprehensible: there is no integrity, coherence and completeness in the text	
-4	Internal logical connection between the parts of the text (coherence) is incomprehensible	
-3	Absence of text integrity	
-2	Absence of text completeness, terms semantics is incomprehensible	
-1	Text structure is clear, there is logical connection between the parts, however general meaning of the text is not clear	
0	Main parts of the documents are clear, general meaning of the text is clear	
1	The structure of the text is clear, there is logical connection between the parts, meanings of some terms used in the text are clear, general meaning of the text is clear	
2	The structure of the text is clear, there is logical connection between the parts, meanings of the major terms are clear, general meaning of the text is clear	
3	The structure of the text is clear, there is logical connection between the parts, meanings of the terms are clear, general meaning of the text is clear	
4	The structure of the text is cleat, there is logical connection between the parts, general meaning of the text is clear	
5	The document is completely clear and is highly structured	

Auditor fulfills the table by all three criteria. Every table can have only one mark. The process of text study and fulfilling the tables has to be performed on every set of documents, then on every set of private indexes, then on every private index.

"Observation" method. The process of observation consists of stages: preparation for observation, observation, observation results analysis.

On the first stage the documents of personal data processing (standards, rules, instructions, etc.) that were defined at "Audit initiation and planning" stage are attentively studied one more time. Structural subdivisions, where the observation take place, are defined at the same stage. If one process is conducted in several structural subdivisions, it will be divided on subprocesses. All data: amount of the processes and their names, names of structural subdivisions should be input in fuzzy logic controller. The fuzzy productions base is generated.

In the process of observation table 2 should be fulfilled by every process.

Table 2 – The evaluation of process performance degree

Scale	Linguistic meaning of process execution characteristic	Mark
-5	The process is not completed	
-4	90% of operations/actions are not completed and 10% are completed	
-3	80% of operations/actions are not completed and 20% are completed	
-2	70% of operations/actions are not completed and 30% are completed	
-1	60% of operations/actions are not completed and 40% are completed	
0	50% of operations/actions are completed and 50% are not completed	
1	60% of operations/actions are completed and 40% are not completed	
2	70% of operations/actions are completed and 30% are not completed	
3	80% of operations/actions are completed and 20% are not completed	
4	90% of operations/actions are completed and 10% are not completed	
5	All operations/actions of the process are fully completed	

In the last column of the table only one mark can be established.

Scale matching the established mark should be input in fuzzy logic controller. Gradation values are entered on all subprocesses or processes of every private index.

"Staff interview" method. The aim of staff interview is to evaluate process of ensuring informational security in organization, qualification of staff, staff knowledge of their functions and staff awareness in the field of informational security. Intercommunication and survey are used as methods of interview. In case of survey the auditor should prepare questionnaires. Depending on the quantity of the staff working in organization and on available time the auditor chooses one of the methods. Structural subdivisions and their staff that need to be interviewed are determined at the stage of audit initiation. Of course, the content of the questionnaires should correspond to studied private indexes. As a rule interviews must be reconciled to the data processing and "Observation" method.

These data should be input in fuzzy logical controller for generation of fuzzy productions base.

According to the results of conducting one or another method auditor should fill in table 3.

Table 3 – The evaluation of staff awareness

Scale	Linguistic meaning of survey results evaluation	Mark

-5	There is no awareness and knowledge about subject of the study	
-4	The level of awareness and knowledge about subject of the study is very low (correct answers were given to 10% of questions)	
-3	The level of awareness and knowledge about subject of the study is low (correct answers were given to 20% of questions)	
-2	The level of awareness and knowledge about subject of the study is below the average (correct answers were given to 30% of questions)	
-1	The level of awareness and knowledge about subject of the study is almost average (correct answers were given to 40% of questions)	
0	The level of awareness and knowledge about subject of the study is average (correct answers were given to 50% of questions)	
1	The level of awareness and knowledge about subject of the study is sufficient (correct answers were given to 60% of questions)	
2	The level of awareness and knowledge about subject of the study is sufficient (correct answers were given to 70% of questions)	
3	The level of awareness and knowledge about subject of the study is sufficient (correct answers were given to 80% of questions)	
4	The level of awareness and knowledge about subject of the study is good (correct answers were given to all questions)	
5	The level of awareness and knowledge about subject of the study is deep (correct and detailed answers were given to all questions)	

In the last column of the table only one mark can be established.

Scale matching the established mark should be input in fuzzy logic controller. Gradation values are entered on all interviews within the framework of private index.

Received data analysis

Process of document estimation is implemented as follows:

1. For every document of every set of documents of private index p_{uvs} :
   - value of criteria features of j^{th} document of i^{th} set of document is input in fuzzy logic controller: α_1(ICD), α_2(CD), α_3(FD);
   - performed fuzzy inference value of the quality of the current document β_{ij}.

2. After evaluation of all set of documents of i^{th} set of document ($\beta_{ij}|j=[1,m]$, m – quantity of documents in the set), performs a calculation of the current value of the quality of the document set (β_i). The β_i is calculated by fuzzy logic controller. Used for the calculation of fuzzy logic controller. Input linguistic variables – (β_{ij}).

3. After the set of documents evaluation of private index p_{uvs} value output of the degree of documentation d^1_{uvs} is implemented.

The process of observation results evaluation is concluded in following:

1. For every i^{th} process of corresponding private index p_{uvs}:
   - values of scale of all subprocesses are input in fuzzy logic controller: α_{ij}, j=1, m; m – subprocesses quantity of i^{th} process;
   - performed fuzzy inference of quality of the current document (β_{ij}).

2. Value output of the degree of implementation d^2_{uvs} is implemented after evaluation of all processes of private index p_{uvs} .

The degree of staff awareness d^3_{uvs} is calculated similarly.

After this we can define compliance level L_{uvs} for the private index. Input linguistic variables are d^1_{uvs}, d^2_{uvs} and d^3_{uvs}.

Group indexes are evaluated similarly after evaluation of compliance level of private indexes. Input linguistic variables are compliance level of private indexes, which belong to current group index.

The compliance level personal data security insurance system is the root of hierarchical index system.

Conclusion

Described method of evaluation of current personal data security condition is interesting because it is flexible to changes in legislation in the field of personal data security and flexible to settings of auditee.

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USING SOLID WORKS FOR ANALYSIS OF EFFECTIVE PULSE OF BLAST CLEANING INTERNAL SURFACE OF GAS CYLINDER

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Method and apparatus for cleaning the internal surfaces of gas cylinders pulsed fraction are proposed. Numerical analysis in Solid Works and industrial prototype testing confirmed the effectiveness of the installation of the proposed method.
Keywords: maintenance, cleaning, internal surface vessels, pulse blasting, numerical methods

The most important prerequisite for the effective and safe use of gas cylinders is their full and timely maintenance.

The main factor affecting the reliability of the gas cylinders and its main properties (reliability, durability, maintainability, and retention) is the wear of elements of the gas cylinders and its components. It is difficult to diagnose without special test equipment and highly skilled operating personnel.

If the diagnosis of wear outer surface of gas cylinders is not difficult, the determination of the degree of wear inner surface causes a serious problem in the inspection of gas cylinders. Problem correct establishing allowable limit of wear of gas cylinders is very important, since they are sources of increased man-made hazards.

There are two main ways to clean the inner surface of the gas cylinders: mechanical and blast cleaning.

We have previously discussed the advantages and disadvantages of each method [1, 2], and provided a method for cleaning the interior surfaces of gas cylinders by pulsed fraction.

This paper presents a numerical analysis of the movement of steel shot with the size dmin = 0,7 mm and dmax = 1,0 mm inside the gas cylinder (volume (V) 10 l, diameter (D) 140 mm length (L) 900 mm) in a medium Solid Works (Figure 1). Numerical experiment allowed pre-selecting the necessary cleaning modes and designing parameters.

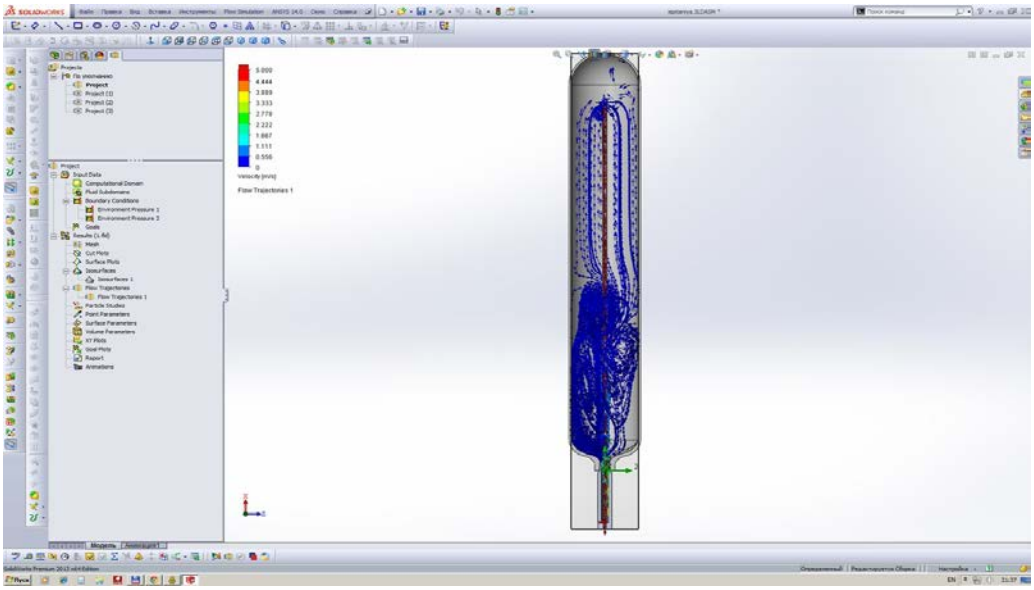

Figure 1 - Calculation of the path of movement of steel shot (dmin = 0,7 mm, dmax = 1,0 mm) inside the gas cylinder (V = 10 l, D = 140 mm, L = 900 mm)

Numerical experiment allowed to pre-select modes of process and design parameters: inlet air pressure, the magnitude of the input orifice fitting, the mass of steel shot, the installation location and the construction of internal reflectors flow.

For the formation of a vortex within vessel was decided to establish the reflectors at the nozzle exit and to create vacuum in the outlet of the cylinder.

Problem of selecting the appropriate design and selection of the optimal input air pressure solved using software environment Solid Works (Figure 2).

To simplify the calculation model of the design some elements which have no significant effect on the treatment process (bevel groove, filters, etc.) were excluded.

Estimated movement of steel shot inside the gas cylinder for air was obtained as dependence of the distance to the reflector output nozzle at an air pressure at the inlet of 0.4, 0.5 and 0.6 MPa (Figure 3).

The obtained results allowed a pre conclude that the increase in air pressure at the inlet is significantly enhances the intensity of the process, and the optimal value of the distance from the inlet fitting to the reflector is equal 15÷20mm.

As a result of industrial testing was obtained dependence between the number of steel shot into the gas cylinder and quality of cleaning the inter surface at the above stated parameters.

Dependence of the degree quality of cleaning of surface from corrosion products (rust) or contamination was also obtained by experiment (Figure 4).

The experimental results showed that a satisfactory quality of the inner surface of the gas cylinder, without rust spots, is achieved within 10 ... 20 min of treatment.

Obtained during factory tests cleaning effect (Figure 5) fully confirms data obtained by preliminary calculations.

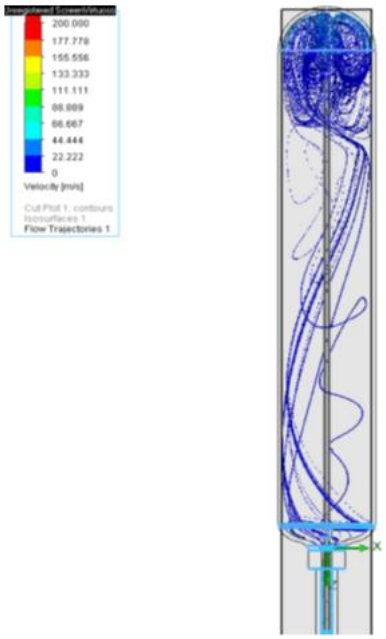

Figure 2 - Estimated movement of steel shot (dmin = 0,7 mm, dmax = 1,0 mm) inside the gas cylinder V = 10 l, D = 140 mm, L = 900 mm

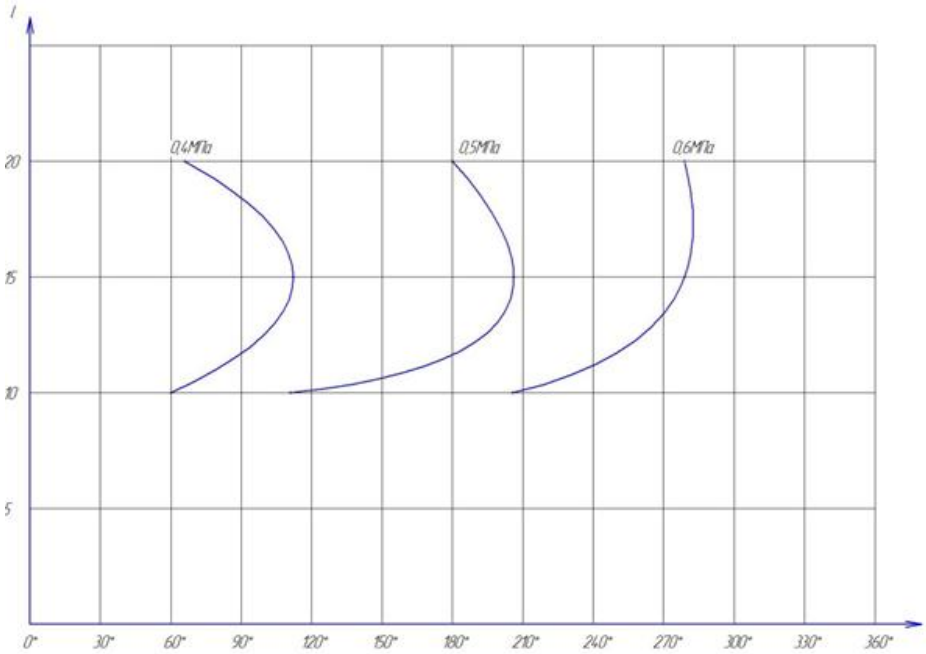

Figure 3 - Dependence of angle of turbulence in gas cylinder as dependence of the distance to the reflector output nozzle at an air pressure at the inlet of 0.4, 0.5 and 0.6 MPa

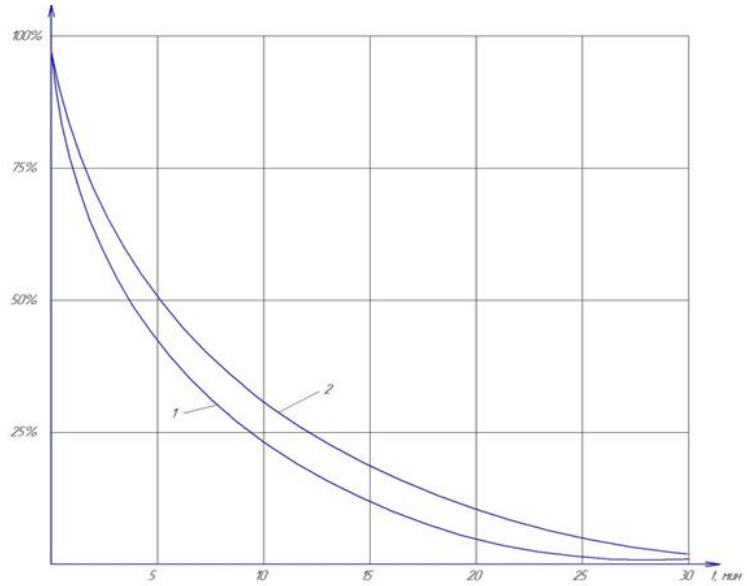

Figure 4 - Dependence the time of cleaning from degree of contamination of corrosion products: 1 - the neck of gas cylinder, 2 - the bottom of the cylinder

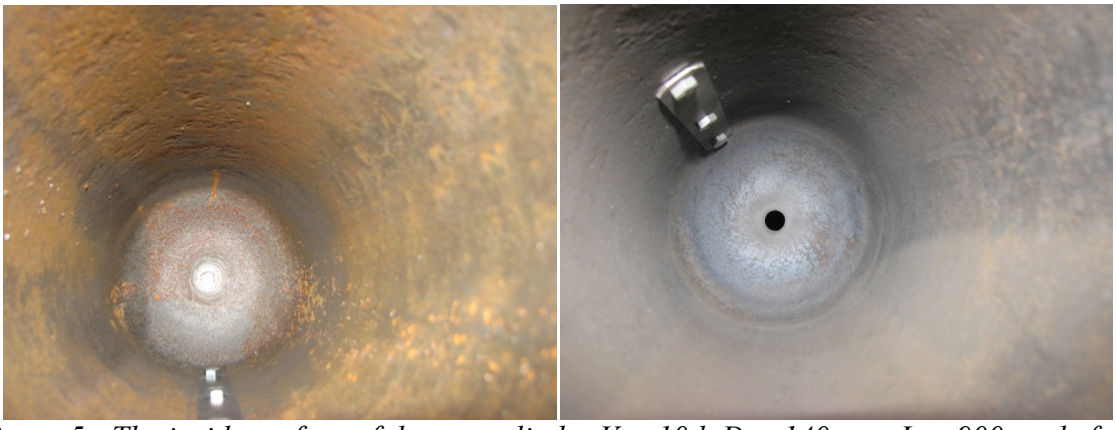

Figure 5 - The inside surface of the gas cylinder V = 10 l, D = 140 mm, L = 900mm before and after cleaning using the proposed method

Conclusions:

1) The proposed method of impulse blasting of steel shot as shown by the results of numerical experiments and industrial trials is highly efficient and allows cleaning the inner surface of the quality of the gas cylinder over the entire length, including the neck and bottom of the vessel.

2) Application of CAD-systems for solving engineering and technological problems means can not only reduce development time, but also allows you to conduct a preliminary assessment of the design and optimal process parameters of the newly developed devices.

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THE USING OF AGENTS AND FUZZY NEURAL NETWORKS FOR MAINTENANCE AND REPAIR ON EXAMPLE OF ROAD-BUILDING MACHINES

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This work is defines the problems and tasks solving of organization of maintenance and repair on example of road-building equipment (RBE). The approaches to decision making support (DMS) in managing the maintenance and repair of road equipment are analyzed. The structure of repair and maintenance organization (MRO) system with the using of agent based on fuzzy sets is determined. Results of elaboration and implementation of modules of a comprehensive RBE Maintenance and repair software-organizational system are described.

Keywords: decision making support; road-building equipment; equipment; maintenance and repair; maintenance and repair organization (MRO); program and information support; fuzzy sets; fuzzy logic; intelligent agents; multi-agent system (MAS); fuzzy neural networks.

Introduction

Modernization of road management allows you to jump to the new management system aimed at achieving results and improving the efficiency of functioning of the industry. One of the objectives of the reform is the improvement of management techniques, which include the best of modern approaches to the organization of maintenance service and repair (MRO) for maximum execution road repair machines production program. Much expressway business park equipment is not enough, that leads to wear and working life of the machines. The most obvious solution, at first glance, is the updating of equipment for replacement of the spent. However, the economic rationale of such transactions is not always convincing. More important task for decision is to develop an apparatus for organization of the system of organization, planning and decision support for maintenance and repair of the fleet of road-building equipment.

A decision concerning MRO knowledge organization

Because there is incomplete information about the state of the equipment, it is necessary to apply the appropriate methods. Account of the unreliability of knowledge can be performed using different approaches, widely known of which are: the odds confidence, fuzzy sets and fuzzy logic, probabilistic approach based on Bayes' theorem, the modified Bayesian approach, theory of evidence (justification) Dempster-Shafer etc.

Coefficient of confidence (CC) is an informal assessment that the expert adds to a conclusion. Formula CC is not to distinguish the case of contrary evidence from the case of insufficient information, which is sometimes useful [14,15].

Fuzzy sets in identifying and describing the characteristics of the objects operate not only quantitative, but also qualitative values. Interpretation of qualitative values is subjective, i.e. different people (subjects) can interpret them differently. Into force of the unclear (blur) qualitative values, if necessary transition from them to the quantitative values of challenges [16,17,18].

Probabilistic approach based on Bayes' theorem is based on the assumption that, knowing the frequency of occurrence of the events, we can argue about the frequency of occurrence of subsequent event combinations. A priori (unconditional) probability is the probability assigned to the event (hypothesis) in the absence of knowledge, contributing to his attack. Such knowledge is also called evidence or grounds. P (event) denotes a priori probability

of the event. Thus, even with scattered information you can calculate posterior probability [14,15].

The most known methods of accounting incomplete and non-homogeneities conclusions are: non-monotonic Macdermott and Dole logic, logic defaults Reuter, non-monotonic logic McCarthy, the system defaults and modify the attributes and methods of the frame and object-oriented models renovated, etc. For organization reasoning in intelligent systems with incomplete knowledge instead of the traditional deduction applies abduction. Абдукцией refers to the process of formation of explanatory hypotheses on the basis of the set theory and the available observations (facts) [19].

Because when describing the state of the art is mostly operate on quality indicators for maintenance and repair techniques may be applied method on the basis of fuzzy neural networks.

A model of the multi-agent system maintenance and repair of road-building machines

For monitoring, organization of interaction and to facilitate the management of a similar structure objects is used agents United in a multi-agent system (MAS). MAS Model, originally developed for submission to the processes of interaction of a set of objects with similar patterns, successfully applied in many different scientific sectors [7]. Use of this model in the areas of robotics and data mining has led to the development of the concept agent, as the object with the privileges of the user and able to commit a similar range of tasks. Thus, an agent is a complex system on fuzzy sets.

Due to variety and different territorial road-building machines and equipment is reasonable to use agent based modeling technologies for the decision of problems of Maintenance and repair. Agents have characteristics, which make them indispensable in the tasks of Maintenance and repair. The ability to correctly respond to the dynamically changing conditions makes multi-agent systems flexible for use in the maintenance of road equipment, so as road repair machine is quite independent, and the situation in it is changing dynamically. Agents have the properties of flexibility, scalability, and fault tolerance. In MAS tasks are distributed between the agents, each of which is considered as a member of the group or organization. Distribution of tasks requires the assignment of roles to each of the group members, definition of measures of responsibility and requirements to the experience [20].

When using all the methods of analysis of equipment MRO works in the framework of the automated system using agents you can speed up the drafting and quality of plans realization of works on Maintenance and repair of equipment. In accordance with this, we propose the following model of the multi-agent system Maintenance and repair [10].

The distributed solution of the tasks of several agents divided into the following steps:

1) Agent manager machine performs the analysis of the failures of internal nodes and prioritize their repair;

2) These tasks are distributed between the executive agents;

3) Each agent-contractor solves its problem, sometimes also dividing it into subtasks;

4) To obtain a general result is performed composition, integration of private results corresponding to the selected objectives;

5) The agent manager machine is using to determine the priority of repair of road-building machines, based on the scale of importance, which is obtained on the methodology of the RCM.

For agents to date, proposed and used much different architecture. Information about some of these is listed below in the table.

Kinds of Agent architectures	
InteRRaP	architecture for managing agents in a dynamic environment

Cougaar	agent architecture, and distributed applications based on agents
JACK	Customizable agent architecture. Commercial, closed
3APL	architecture for cognitive modeling agent
JADEX	Purposeful behavior Architecture
LSfTS	Customizable LSfTS agent architecture. Commercial, closed

For this task InteRRaP agents architecture is selected. In this architecture, the monitoring subsystem agent is multi-level, each higher level with more of an abstract (and the aggregated information.

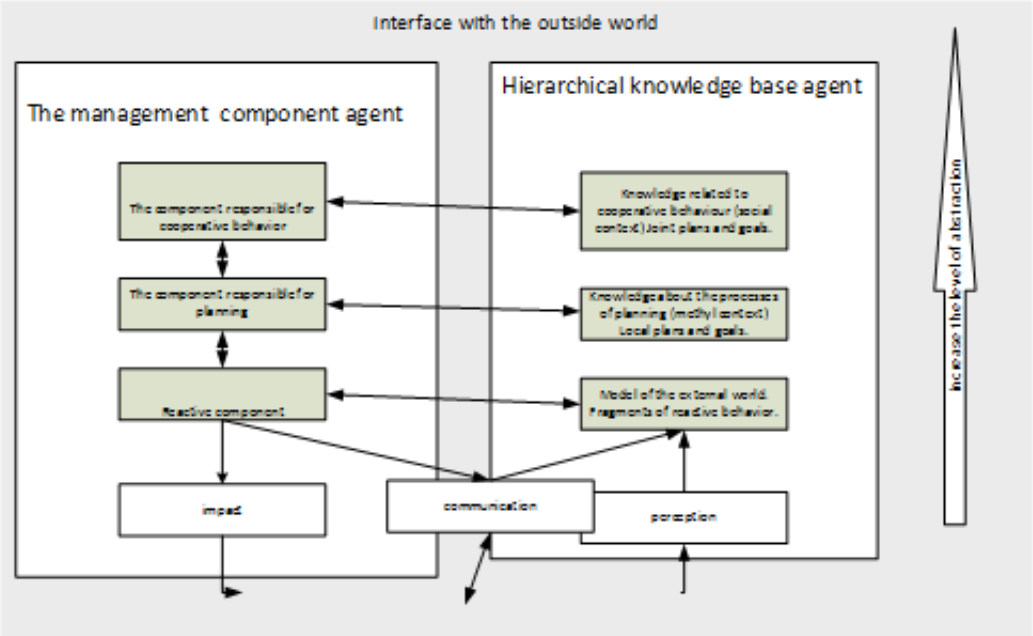

Fig. Architecture MRO road equipment system based on multi-agent

Conclusion

Problems and formulation of tasks on equipment maintenance and repair organization in the road sector was analyzed. The basic methodology of maintenance and repair organization for creation of MRO system in the road sector (reactive maintenance, preventative maintenance and RCM) was defined. Within the work of the proposed approach is to provide decision-making support in managing the Maintenance and repair of road equipment based on the adapted and modernized method RCM2. It is shown that the costs of Maintenance and repair are equal to the sum of operating costs and production losses. The structure of the system of organization of repair and maintenance of the road sector with the use of ontology and multi-agent systems was determined. The use of ontology for the task of knowledge management on the MRO is shows. Produced rationale for the use of agent based modeling technologies for the decision of problems of Maintenance and repair. Developed composition of agents and model of the MRO system based on agents as a multi-agent system. The structure of intelligent agents corresponding to the model was built. For the scheduling of maintenance and repair is used Case Based Reasoning method for output to the ontology. Introduction of the system is based on the regional state enterprise on construction and repair of roads. Development and implementation of comprehensive software-organizational systems are produced in stages.

Currently [21,22] implemented with the economic effect of the system of automated accounting of road construction enterprises and collects information on conducted operations, which is taken into account in the prototype Decision Support System.

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ZEEMAN LASER GYRO IN QUASIFOURMODE REGIME

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Zeeman laser gyro optimized mathematical and software provision permitted to increase the devices accuracy by 10 times is presented.

Keywords: laser gyro, mathematical and software provision

Laser gyros are applied more and more in the navigation and control systems of the different class of accuracy, being especially demanded in the range of 0.1 – 0.005 °/h.

Laser gyros with magnetooptical biasing combines the inherent laser gyro accuracy potential and extremely high exploitation characteristics being unachievable for other types of gyros such as mechanical, fiber and hemispheric resonant gyros, etc. (ready time 1-3 s, shocks 150 g, vibration 35 g in the range of 20 Hz – 2 kHz, temperature range –55…+70 °C).

In Russia the magnetooptical laser gyros with original design covered by patents (first patent was taken in 1964) are being produced by JSC "RDI "Polyus" named by M.F. Stelmakh". This laser gyro has biasing on Zeeman effect. Nondithered laser gyros with magnetooptical biasing are named "laser gyros of the second generation".

One of the main advantage of the laser magnetooptical gyros is the possibility of realization the fourmode generation, thus providing the compensation of the correlated magnetic-nature errors and by that the improvement accuracy of these devices.

The known method of creation the conditions for fourmode generation in the ring laser by the special design of the resonator and by the specific readout device to realize the definite four frequencies combination presents some difficulties.

New approach of the fourmode concept is so called quasifourmode Zeeman laser gyro. In such gyro the resonator design and the readout device are the same as in twomode one, while the fourmode regime is provided by electronic switching (reversing) of two pairs of frequencies (modes) with orthogonal polarizations in pairs. Thus instead of complicating the design a problem is passed to electronic and software-mathematical methods of the mode switching with further processing of the gyros output signals, that is easily decided at the modern level of microcomputer [1].

The switching from one generation mode to another is made by the ring laser perimeter to be changed with help of the perimeter control system accordingly to given algorithm. This algorithm is also used for compensation of the information accuracy short-term decreasing occurred in the mode switching moment.

Experimental results proved that developed Zeeman laser gyro optimized mathematical and software provision permitted to increase the devices accuracy by 10 times without limitation of dynamic characteristics.

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THE CONTROL OF THE MICROWAVE PLASMA CHEMICAL REACTOR THERMAL MODE

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The aim of this paper is to describe the importance of temperature measurement for natural gas conversion process in microwave plasma chemical reactor and evaluate the accuracy of measurements. Microwave plasma chemical reactor is the installation for conversion of natural gas into hydrogen and carbon nanomaterial.

Keywords: Microwave plasma chemical reactor, temperature measurement, carbon nanomaterial, hydrogen, natural gas.

The problem of deep processing of hydrocarbon raw materials requires a search of new approaches and solutions. One of them is conversion of natural gas (methane) into carbon and hydrogen.

The staff of Institute of Physics and Technology of National Research Tomsk Polytechnic University have developed a technique and created the installation for conversion of natural gas (methane) into carbon nanomaterial and hydrogen[1]. This method is based on the combined effect of the catalyst and the plasma of the microwave reactor to gas. This physical-chemical effect allowed to obtain a high degree of natural gas conversion equal 76 % [2].

An important part of the nanomaterial reception process is the control of the microwave plasma chemical reactor thermal mode. When conducting temperature monitoring, we can draw a conclusion about the beginning of natural gas decomposition reaction. At the first stage the metallic catalyst (Fe, Ni, TiNi) is heated in the installation by means of ultra-high frequency

(UHF) energy within the nitrogen current up to temperature ~560°C thanks to dissipative losses. Then cold natural gas (~30°C) is provided to the reactor, nitrogen supply is cut out and microwave discharge appears in the discharge chamber. Thus, the temperature of the catalyst is decreased to 450 - 480 ° C depending on the methane flow. Fixing the temperature changes we can make a conclusion about the beginning of the decomposition reaction.

The control of temperature is carried out with the help of the pyrometer "Kelvin". There are three quartz windows throughout the height of the reactor for controlling catalyst temperature. Pyrometers do not require any contact of a measuring device sensor with the body whose temperature is measured. Therefore, a pyrometer can be used to measure very high temperatures. The pyrometer "Kelvin LCM 1300" has good metrological characteristics.

In real conditions the pyrometer doesn't always accept all radiation of the controlled object. Such objects as vapour, dust, sight glasses, or, for example, installation elements can cause decrease of radiation captured by the pyrometer. The intermediate medium found on the way of the pyrometer rays are shown in Fig.1

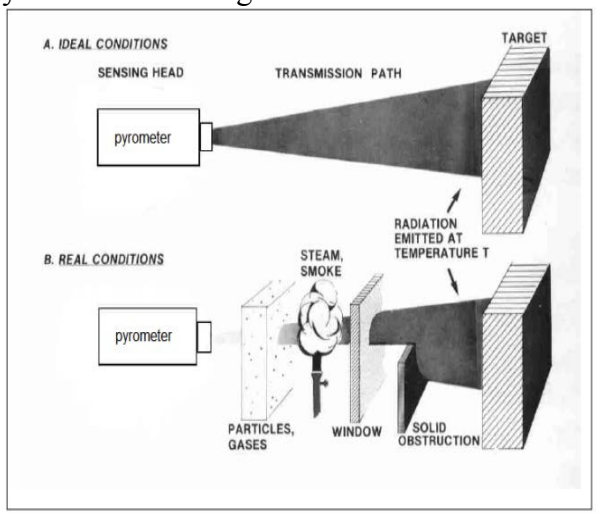

Fig.1. Intermediate medium found on the way of the pyrometer rays.

To identify and evaluate temperature measurement error/accuracy of the catalyst the experiment was carried out. In the experiment a nichrome spiral was used as a control object. At first, the spiral temperature was measured through the air gap, and then through the quartz window (two samples of different thickness are used) with the help of the pyrometer "Kelvin" installed at a distance of 80 cm from the spiral. The quartz window was placed on the way of the pyrometer rays at a distance of 14 cm from the spiral. At first, the spiral temperature was measured through the air gap, and then through the quartz window (two samples of different thickness are used) with the help of the pyrometer "Kelvin" installed at a distance of 80 cm from the spiral. The quartz window was placed on the way of the pyrometer rays at a distance of 14 cm from the spiral.

Table 1. Results of experiment.

Sample	T, °C (measured through the air gap)	T, °C (measured through the quartz window)
One sample, thickness is equal to 4 mm	577	385
Two samples, common thickness is equal to 8 mm	577	266

From the table 1 we can see that the temperature measured through the quartz window and the temperature measured through the air gap are different. It is so because the radiation registered by the pyrometer includes the following components:

$$\Phi_{\sum} = \left(\varepsilon \times \Phi_{Obj}\right) + (\rho \times \Phi_{\mathrm{Amb}}) + (\tau \times \Phi_{\mathrm{Back}})$$

Where ε –emission coefficient of the measuring object, ρ – reflection coefficient of the measuring object, τ - transmission factor of the measuring object

We can see structure of radiation registered by the pyrometer in Fig.2:

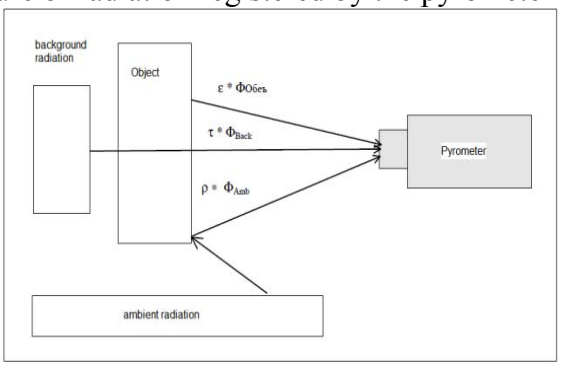

Fig.2. Structure of radiation registered by the pyrometer.

According to the energy conservation law the sum of the coefficients of the emitted (ε), reflected (ρ)and transmitted (τ) energy must be equal to 1.

$$1 = \varepsilon + \rho + \tau$$

For opaque measuring objects the equation is simplified:

$$1 = \varepsilon + \rho$$

So, when registering radiation by the pyrometer, we should to consider not only the coefficients of emission and reflection of a spiral, but also the emittance, reflectance and transmittance coefficients of the quartz window.

The experiment has shown that when the catalyst temperature is measured in the microwave plasma chemical reactor in real conditions, we should take into account that the quartz window located on the way of the pyrometer rays causes a decrease of the captured radiation. Thus, there is significant difference between the temperature which was measured through the air gap and the temperature was measured through the quartz window(~ 192 ° C) . It should be taken into account while programming automatic control system for measurement of reactor's parameters.

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MAGNETIC PARTICLE TESTING OF AEROSTRUCTURES

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The aim of the paper is to describe the performance of magnetic particle testing with using of modern equipment and assess the reliability of method for testing aerostructures.

Keywords: non-destructive resting, magnetic particle testing, aerostrutures.

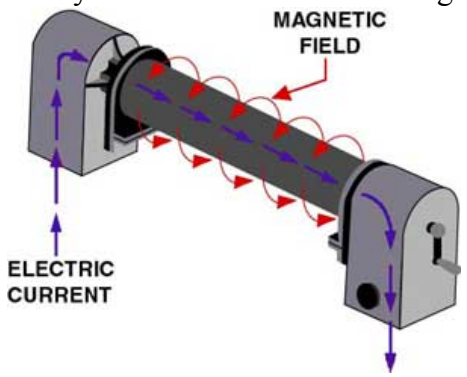
Magnetic particle inspection (MPI) is a nondestructive testing method used for defect detection. MPI is fast and relatively easy to apply, and part surface preparation is not as critical as it is for some other NDT methods. These characteristics make MPI one of the most widely utilized nondestructive testing methods.

MPI uses magnetic fields and small magnetic particles (i.e.iron filings) to detect flaws in components. The only requirement from an inspectability standpoint is that the component being inspected must be made of a ferromagnetic material such as iron, nickel, cobalt, or some of their alloys. Ferromagnetic materials are materials that can be magnetized to a level that will allow the inspection to be effective.

The first step in a magnetic particle inspection is to magnetize the component that is to be inspected. If any defects on or near the surface are present, the defects will create a leakage field. After the component has been magnetized, iron particles, either in a dry or wet suspended form, are applied to the surface of the magnetized part. The particles will be attracted and cluster at the flux leakage fields, thus forming a visible indication that the inspector can detect.

For detecting of defects with different orientation the different methods of magnetization should be used. There are two main methods of magnetization: direct and indirect.

There are several ways that direct magnetization is commonly accomplished. One way involves clamping the component between two electrical contacts in a special piece of equipment. Current is passed through the component and a circular magnetic field is established in and around the component. This way is better to use for detecting longitudinal defects.



Pic.1. Direct magnetization of component (one of possible ways).

In the experiment the current source MAGMAN 4000 was used. High current generator MAGMAN series are designed to generate of magnetic field for magnetic particle testing.

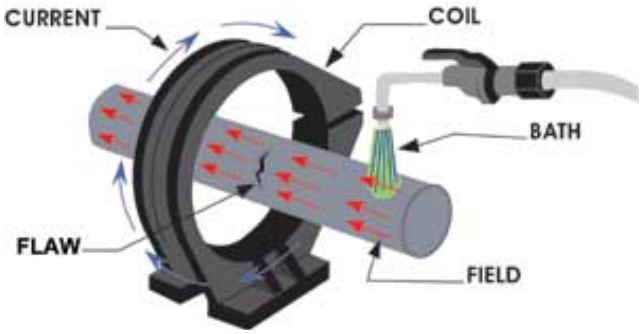
The performance of first step of testing:

1. Clean the object of testing
2. Adjustment of high current generator for getting needed value of magnetization
3. Spraying of suspension to the object
4. Magnetization of object and spaying of suspension in time
5. Switch off the equipment and visual testing of control object with using the UV lamp
6. Documentation of detecting defects
7. Clean the control object

The next step of the experiment: magnetizing the control object for detecting transverse defects. For this purpose the UNIMAG 1200 was used.

UNIMAG 1200 is equipment for non-destructive testing of ferromagnetic materials. It can be used for direct and indirect magnetization. Indirect magnetization is accomplished by using a strong external magnetic field to establish a magnetic field within the component. As

with direct magnetization, there are several ways that indirect magnetization can be accomplished. In this equipment the coil was used. When the length of a component is several times larger than its diameter, a longitudinal magnetic field can be established in the component. The component is placed longitudinally in the concentrated magnetic field that fills the center of a coil.



Pic.2 . Indirect magnetization with using coil.

The performance of second step of testing:

1. Clean the object of testing
2. Adjustment of equipment for getting needed value of magnetization
3. Spraying of fluorescent suspension to the object
4. Magnetization of object and spaying of suspension in time
5. Switch off the equipment and visual testing of control object with using the UV lamp
6. Documentation of detecting defects
7. Demagnetization of control object
8. Clean the control object

During the test the defects with different orientation were detected. There are examples of detecting indications of defects on the Picture

Pic.3. Indications of defects on the testing object.

In the experiment two ways of magnetization (direct and indirect) were used. This allowed to detect the defects with different orientation and to perform more reliable testing.

Magnetic particle inspection is widespread methods of non-destructive testing of ferromagnetic materials. It is easy to perform with using of modern equipment and reliable for testing of aerostructures.

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ENSURE MAINTAINABILITY DIRECTION FINDER POSITIONS

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Lists requirements to time of recovery equipment direction finder positions is declared. Schemes of radio-directional finder system, direction finder position and control unit for it is presented. The detailed description of the control unit is reviewed.

Keywords: direction finder, communication link, control unit.

On the technical project time of recovery equipment direction finder positions should not exceed 30 minutes. Analysis shows that providing this requirement is known methods is impossible due to the large distances from the base, the complexity of the equipment and the absence, as a rule, the places of deployment positions of highly qualified specialists [1, 2].

The diagram of the radio direction finding (RDF) system is presented in Figure 1.

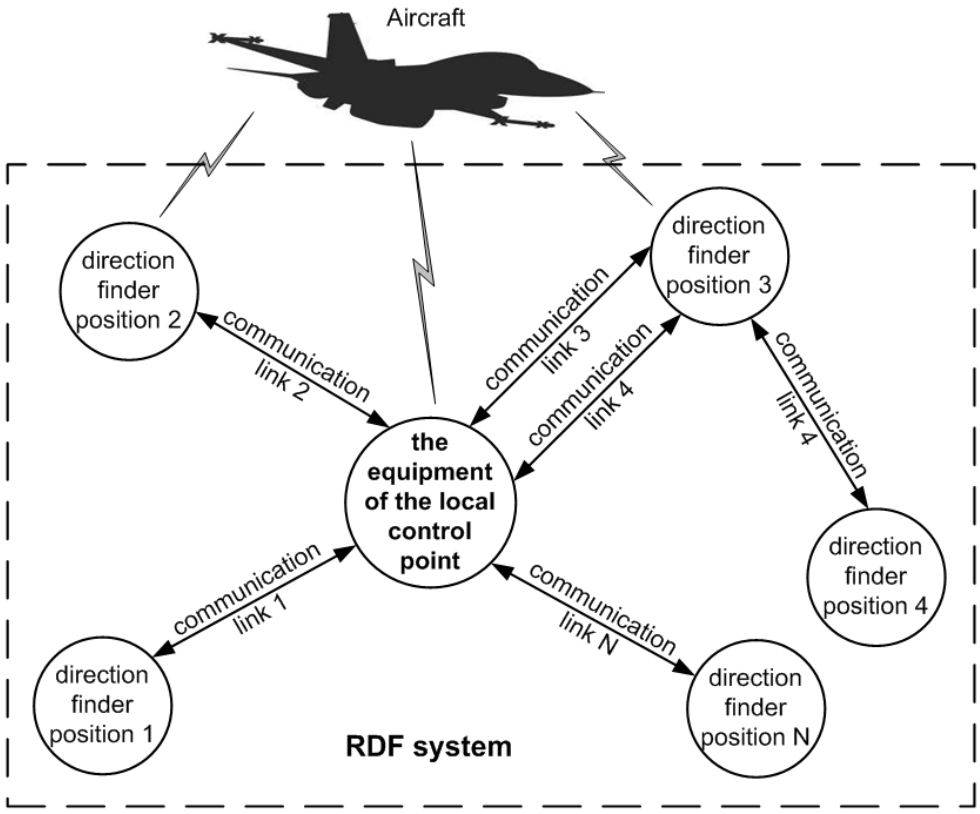

Figure 1. The diagram of the RDF system

The structural scheme of direction finder position is presented in Figure 2.

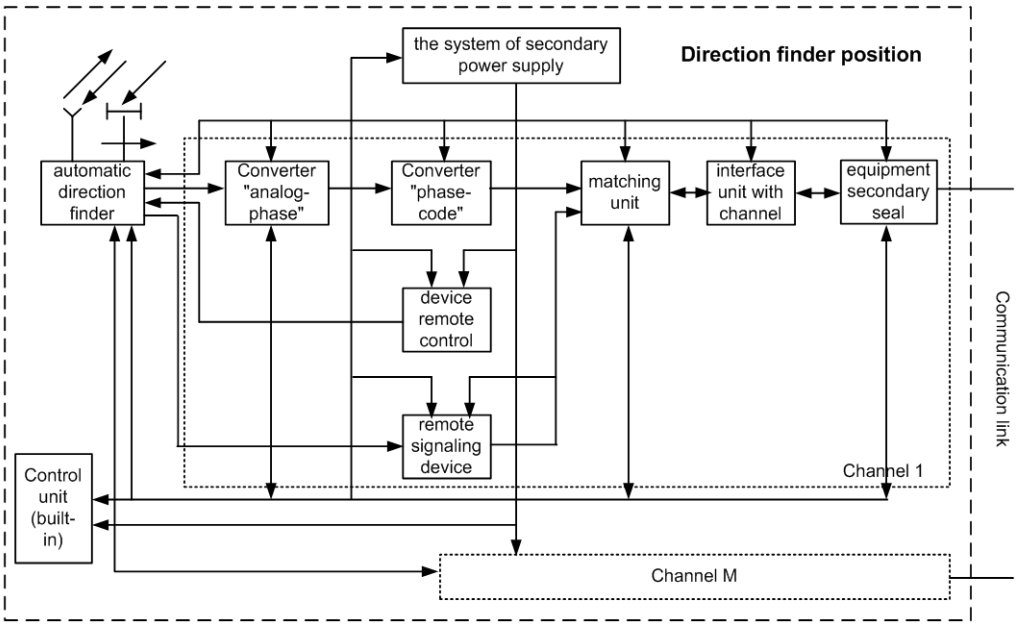

Figure 2. The structural scheme of direction finder position

Designed embedded microprocessor control unit, which allows automatic or automatic modes determine the technical condition of all equipment and troubleshoot it to a removable node in the integral criterion of "norm", "impairment", "accident". Structurally, the control unit is a cassette unit and contains single-board 8-bit microcomputers on the basis of the microprocessor kit series 580, combined with ROM and RAM memory, respectively, 8 and 4 Kbytes, and on the experimental sample and during debugging software ROM is replaced by ROM of the same volume.

The structural scheme of control unit is presented in Figure 3.

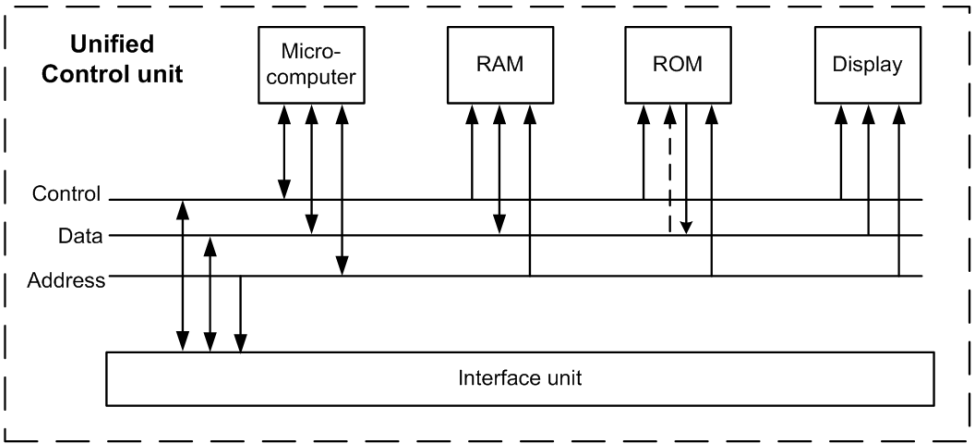

Figure 3. The structural scheme of control unit

The control unit also includes:

– input device-1 logical signals, which allows any sequence or simultaneously record and enter up to 56 signals logical levels;

– input device-2 logical signals, providing input, rationing and memorizing up to 16 permanent or smoothly varying analog signals; here posted by and input device heartbeat;

– device I/O for removal in a mode of listening of information with 5 joints C2-1 and transfer the junction S2-2 in accordance with the common procedure of exchange;

– device control and display unit, which generates signals for direct impact on the monitored hosts пеленгаторной position, as well as displays on the front panel of the control unit on the LEDs and seven-segment indicators all control and diagnostic information about the state of the equipment to a removable site; display any information about the fault is accompanied by audible alarm.

There are two modes of work of the block of automatic and automated. In the first case, control unit on power passes in a mode of automatic control of all the equipment, he self-tested, organizes train at the output of direction finder position in the communication channel, runs the appropriate tests, and identifies the status of all nodes. When identifying one or another fault information is displayed on the front panel of the control unit and transferred in the local dispatching point on the Telegraph channel in accordance with an agreed Protocol. In the second case, the operator dials using the keyboard control unit block number direction finder position and number of interest in its device in this block and presses the START button. The control unit conducts selective control of this device. Results of the audit similarly displayed and/or transmitted into the communication channel [3-5], if the request for testing this device was received with the local dispatching point.

Software control unit implemented in assembler language microprocessor kit series 580 and occupies a volume of ROM 8 Kbytes [7]. Debugging was carried out on the micro-computer SM-1420 using PRAM-4.4.

Block embedded in radio-directional system "Niva" and can be applied on similar systems of air traffic control.

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THE ANALYSIS OF THE RESOURCE MODIFICATION OF TECHNICAL SYSTEMS RELIABILITY

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The article is devoted to the problem of assessing the reliability of complex technical systems. The necessity to reduce the time to identify latent failures and actions in order to reduce the area of uncertainty to identify the state of the object is substantiated.

Keywords: The model, graph, reliability, control, uncertainty.

Reliability index as a resource indicator of a complex technical system (TS) is one of the key indicators and has complex nature of formation and application depending on the source of technical solutions when designing, adopted methodology maintenance and external environment. As the main parameters (indicators) that characterize the reliability is the probability of a safe beat P(t) or probability of failure, connected by the relation P(t)=1-Q(t).[1]

When changing reliable indicators over time P(t)=1 is considered to be corresponded to the ideal case when the system reliability is significant event. If P(t)=0, the system is not reliable and fully characterized by a zero value of such resource as "reliability".

During TS maintenance the multiple process of resource reliability expenditure and recovery takes place, and in the ideal case is considered [2]:

а) process reliability spending may continue to P (t) = 0;

б) when reliability recovering take place a set of measures for, repair and replacement of defective parts of the TS, which provides P (t) = 1 before starting the next phase of operation maintenance are implemented (Fig. 1).

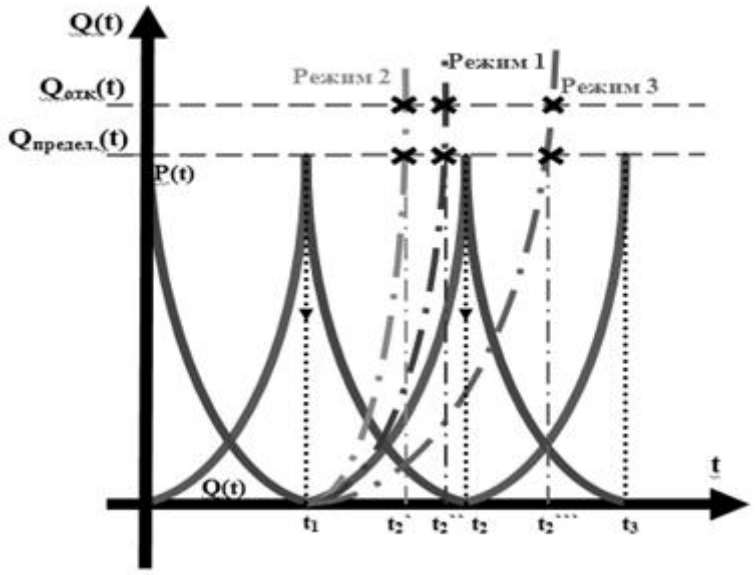

Fig. 1. The ideal case of TS recovery

Domains $(0,t_1)$, (t_1,t_2), (t_2,t_3) are equal and correspond with equal operating conditions (in accordance with TC), the absence of the external factors influence on the technical system, etc. In case of overdriven mode operation schedule Q (t) may have a steeper nature and, conversely, more gentle nature under reducing the load (graphs 1, 2 and 3 respectively in Fig. 2.). In these cases, the time to reach $Q_{отказ}(t)$ and $Q_{предел.}(t)$ may change and at the same time

(t_1,t_2`)<(t_1,t_2``)<(t_1,t_2```). These graphs show the need for a set of measures to regulate reliability index, its actual assessment, monitoring vehicle operating conditions. Otherwise, it may happen that the vehicle operation will realize in the domains (t_2`, t_2), (t_2``, t_2), if we assume that the next stage of plan-prophylactic maintenance occurs at t_2. It remains to say that this period of operation brings the most reliable vehicle damage, leads to additional failures and defects, and leads TS to an unresponsive state, an increase in the measure of uncertainty (entropy) of its condition. As a result of this one of the problems of reliability TS is to reduce the periods (t_i`,$t_{i+1}$). In many cases, the law of functioning TS cannot be determined in this interval, and optimization of reliability lies in the largest decrease this interval min($t_i$`, t_{i+1}), where t_i`- commencement $P(t) \le P_{отк}(t)$ or $Q(t) \ge Q_{отк}(t)$, t_{i+1} – the time of the plan-prophylactic maintenance.[3]

Unfortunately, this case of TS maintenance and change of reliability index is to a certain extent an ideal, because full recovery of reliability is not possible. The above said graph can be drawn as follows (Fig. 2).

By this graph it is noted that the character change S (t), as a rule, is not determined and the value $\Delta Q_i(t)$, associated with a loss of reliability TS depends on the quality of maintenance, the duration of time (t_i`, t_{i+1}), the delivery of resource by TS serviceable elements, the time of vehicle operating since its commissioning, the periodicity of plan-prophylactic maintenance.

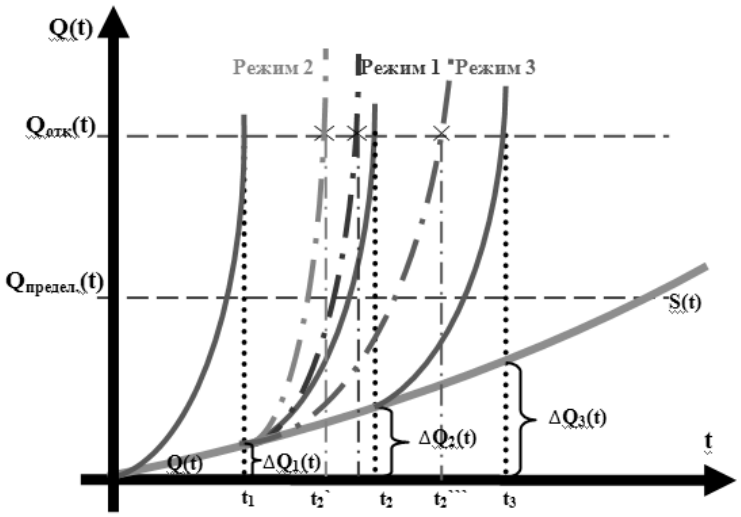

Fig. 2. Change reliability depending on the quality of recovery

In this case, the time to reach the index Q (t) to $Q_{отк}(t)$ is significantly reduced, and undoubtedly, this time is reduced at later stages of operation. The second important and urgent task is to ensure the reliability of the TS reduction ΔQ(t). Due to the random nature of changes in the physical and chemical properties, mechanical and technological parameters of the TS schedule S (t), to our opinion, hasn`t got necessarily a strictly monotone increasing character. You can even suppose that the quality of work to restore the reliability may be different depending on the staff qualifications, the nature of the defect, functioning vehicle history.[4]

In the case when ΔQ(t) reaches the value of $\Delta Q(t) > \Delta Q_{пред.}(t)$, the further operation of the object stops (Fig. 3).

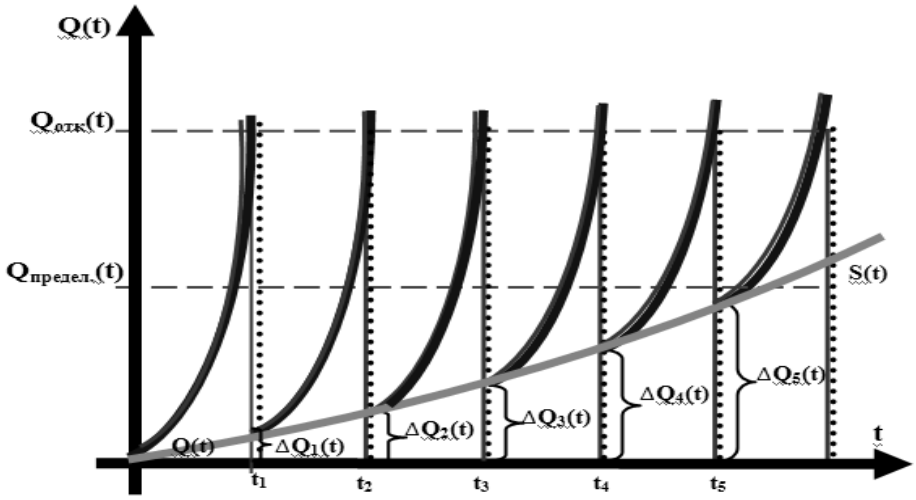

Fig. 3. Multiple iterative process of change and recovery P(t)

In real cases of maintenance control process starts with the detection of failure or when reaching the threshold value of reliability index. At the same time there is uncertainty about the recovery, which depends on:

- the type of failure (intensity)
- the characteristic of systems of monitoring and diagnosing
- the complexity of the analyzed technical object

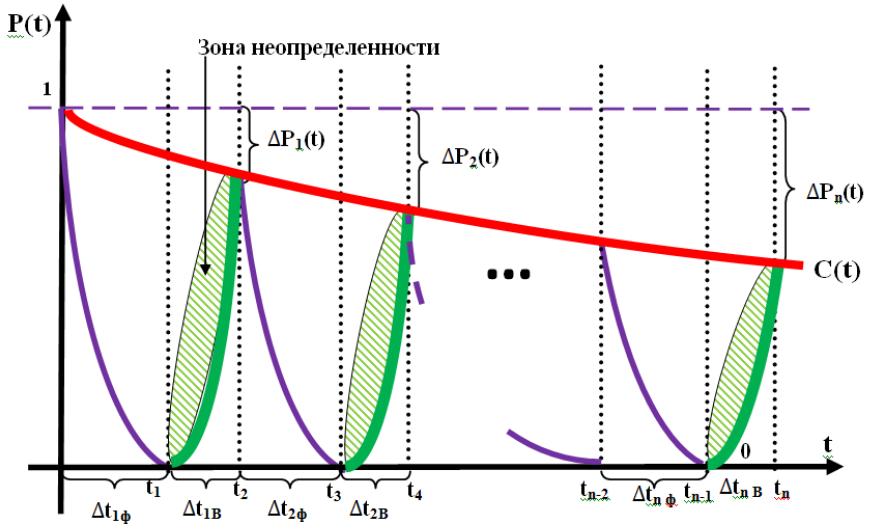

Fig. 4. Process operation and recovery vehicle

($\Delta t_{1ф} \neq \Delta t_{2ф} \neq \ldots \neq \Delta t_{n\,ф}$, $\Delta P_1(t) \neq \Delta P_2(t) \neq \ldots \neq \Delta P_n(t)$)

Another type of uncertainty resulting from the analysis of technical systems is the uncertainty introduced by latent failures. According to the time this uncertainty is divisible by 1 and 2 uncertainties kind.

The first kind of uncertainty occurs when functioning of the facility till the fault has been identified to achieve reliability indicators limiting values of plan-prophylactic maintenance approaching by the object (Fig.5.)

The second kind of uncertainty refers to the second kind of faults of classification system performance monitoring and also, ultimately, is characterized by insufficient qualitative analysis. It means that the task of analyzing is a complex intractable task, which requires the development of new approaches. In particular the task is not only reducing the duration of

uncertainty areas, but also the application of new approaches to change the methodology of monitoring and diagnosing, adaptive regulation of periods and activity of maintenance procedures.

Domain of uncertainty

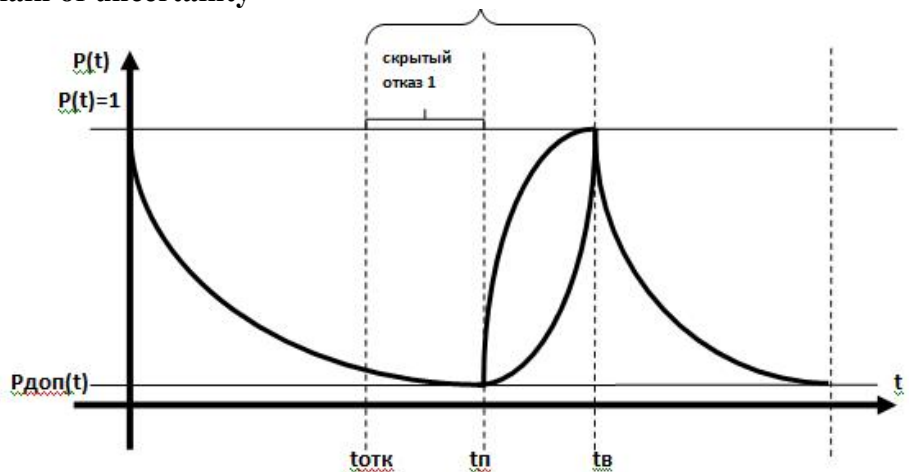

Fig. 5. Domain of uncertainty assessments taking into account latent failures. t omк- the time of failure, t п- time of the threshold value`s achievement, t в- recovery time

In connection with premises the problem of optimizing the process analysis of technical systems is posed, as well as optimization of systems for monitoring and diagnosis, their structure and their functioning algorithms.

In conclusion, it should be noted that the analysis is used in the construction of maintenance`s optimal procedures, monitoring and diagnostics of TS.

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THE METHOD OF DESIGNING OF PART MANUFACTURE

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A method of selecting the optimal approach in part manufacture is developed.

Keywords: surface, detail, billet, processing technique, work tool, technological decision, accuracy of processing, roughness of a surface.

The particular processes employed will largely determine the efficiency of part manufacture. The manufacturing technology is developed manually or with the assistance of automated design systems for manufacturing processes. In any case, the quality of any operation

is determined by the tools employed and the selection of the manufacturing approach—the selection of the methods of part production and machining of its surfaces.

In plants where the processes are manually designed, the data regarding the available components will be incomplete, as a rule. Moreover, the information may be taken from different sources (handbooks, working documents) and in different forms (catalogs, plant documents, etc.). In automated design, the information regarding the components is more orderly and the search for possible approaches is better organized. In any case, however, the selection of the approach will depend on the technologist's experience and qualifications. As a rule, two or three options that are not supported by calculations will be considered; the development of the technological operations is time-consuming; and the outcome is far from optimal.

Obviously, to find the optimal technological operation, as wide a range of components as possible must be considered, and a procedure is required for finding the best means of ensuring the specified surface parameters (shape, dimensions, quality). The method of finding the operation must include selection of the system components in a fixed sequence: the machining method, the tool, the cutter material, and the basing system.

To this end, we have developed a method for selecting an optimal technological operation. As an example, consider the production of a cylindrical hole with specified parameters (diameter, length, precision, surface roughness, etc.), while will somewhat determine the choice of machining method, tool, cutter material, and basing system.

The same surface may be produced by various methods—for example, by cutting, abrasive machining, plastic deformation, or electrophysicochemical methods. Possible cutting methods include piercing, reaming, boring, countersinking, and broaching.

The operation is found on the basis of the system shown in the figure. In selecting the components of equipment for producing holes with specified parameters, we need to know their capabilities—that is, the factors that limit their applicability, such as the shape, size, material, and surface quality of the blank and in some cases the configuration of the surface to be produced. For example, we know that, if boring is to be employed, the hole diameter must be no more than 30 mm, and the blank configuration must not obstruct the free access of the bit. The applicability of the components depends on the dimensional precision, configuration, and roughness of the hole surface.

In Table 1, a plus sign denotes recommended methods of producing holes with the required diameter range, on the basis of handbook data [1, 2]; unfortunately, the handbook data are very inconsistent. Tables 2 and 3 present methods of hole production in relation to the required precision of the diameter and surface roughness, with the following notation: (●) methods recommended by several sources; (○) methods recommended by a few sources for particular conditions.

The initial data for the decision include the hole parameters (diameter, length, precision, surface roughness), its machining conditions (the shape, dimensions, material, and surface quality of the blank, the margin), and the available equipment at the plant.

Table 1. Recommended (+) methods of producing holes of specific diameter

Method	Hole diameter, mm											
	3-6	6-10	10-18	18-30	30-50	50-80	80-120	120-180	180-250	250-315	315-400	400-500
1.Piercing	+	+	+	+								

2.Reaming				+	+	+			
3.Boring						+	+	+	+
4.Countersinking			+	+	+	+			
5.Broaching	+	+	+	+	+	+	+		

Table 2. Recommended methods of producing holes with required diametric precision

Method	Quality class									
	5	6	7	8	9	10	11	12	13	14
1.Piercing					○	○	●	●	●	○
2.Reaming					○	●	●	○	○	○
3.Boring					○	●	●	○	○	○
4.Countersinking			○	●	●	●	●	○	○	
5.Broaching	○	●	●	●	●	○	○			

Table 3. Recommended methods of producing holes with required surface roughness

Method	*Ra* (State Standard GOST 2789-73)														
	0.08	0.1	0.125	0.16	0.2	0.25	0.32	0.4	0.5	0.8	1	1.25	1.6	2	2.5
1. Piercing										○	○	○	○	○	○
2. Reaming										○	○	○	○	○	○
3. Boring								○	○	○	○	○	○	○	●
4. Countersinking								●	●	●	●	●	○	○	○
5. Broaching	○	○	○	○	○	○	●								
Method	*Ra* (State Standard GOST 2789-73)														
	3.2	4	5	6.3	8	10	12.5	16	20	25	32	40	50	80	100
1. Piercing	○	○	○	○	○	○	○	○	●	●	●	●	●	●	
2. Reaming	○	○	○	○	○	○	○	○	○	●	●	●	●	●	
3. Boring					●	●	●	●	●	○	○	○	○	○	

4. Countersinking	● ○	● ○	● ○	● ○	● ○	● ○	● ○	●	●	●	●	●			
5. Broaching															

The search proceeds as follows. The machining methods capable of producing the specified shape of the part's surface are selected. From these, the methods capable of producing the required dimensions are selected. Then each of the remaining methods is investigated in relation to the specified precision and surface roughness. If there are no such methods, we proceed to look for two-pass machining methods(pic.1).

If it is possible to attain the required parameters— diameter, precision, and surface roughness—we compare the specified margin with the recommended margin for obtaining the specified precision and surface roughness, for the particular material. If the specified margin is larger, this method is unsuitable. The best of the remaining methods must be selected—that is, the method characterized by maximum productivity or minimum cost.

The selection of the tool in relation to access to the hole location and the specified diameter, length, precision, and surface roughness proceeds analogously. If the selected tool cannot machine a hole with the specified precision or surface roughness, we must revert to one of the rejected methods and select a tool for that method.

Of the various bit designs, the best in terms of maximum productivity or minimum cost is selected. In the same way, the cutter material and the basing system are chosen.

Example

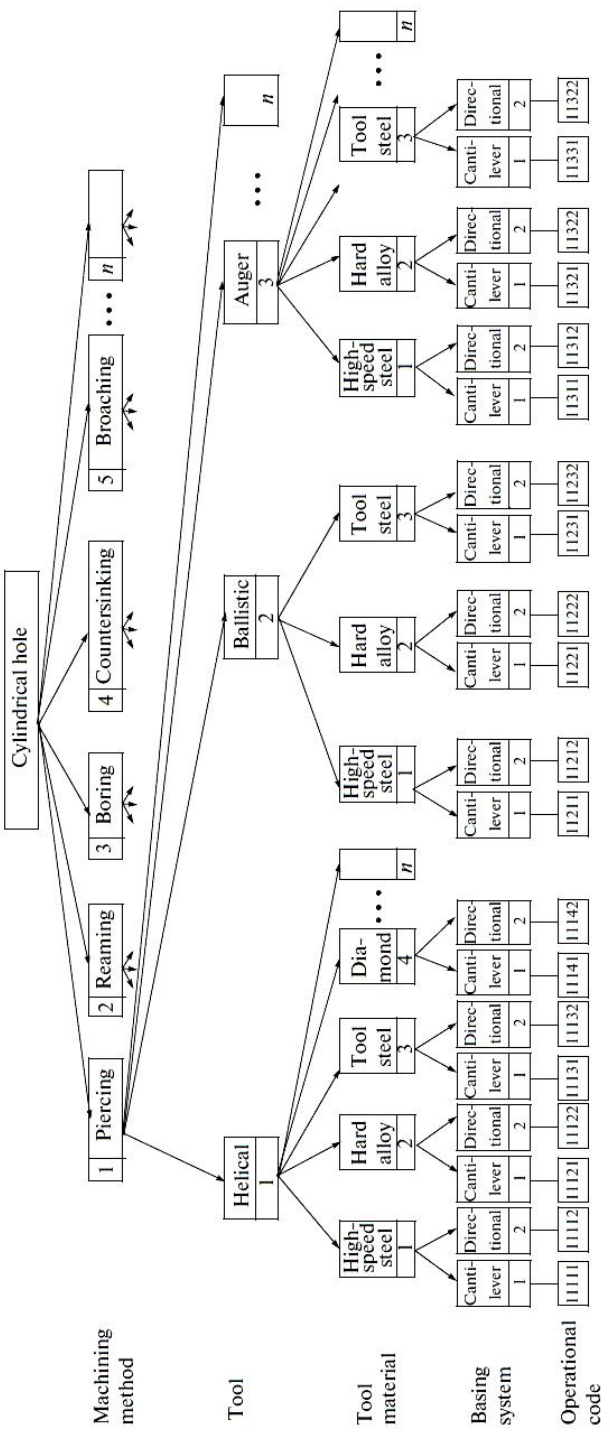
We want to find the production system for manufacturing a part with a hole whose diameter d = 40+025 mm (quality class 12, length l = 100 mm, roughness Ra = 20 μm) from an unquenched steel 45 blank with a hole (diameter dbl = 37 mm).

We consider the following possible methods: piercing, reaming, boring, countersinking, and broaching.

First we determine the method for producing the 40-mm hole. Since the blank already has a hole, that rules out piercing and boring. Of the other methods, we select those that ensure diametric precision no worse than 0.25 mm. Thus, there remain two methods ensuring the required precision and surface roughness: countersinking and broaching. However, in broaching the cutting depth is no more than tenths of a mm, while the margin to be removed is 1.5 mm. Hence, countersinking remains.

One-piece and composite tools both permit the same productivity. Therefore, we look at which is characterized by minimum cost. The use of composite countersinks with an inset hard-alloy tip permits economical use of the expensive cutting material.

Of the possible basing systems for a countersink with l/d = 2.5, we select a cantilever configuration, which ensures the specified precision and surface roughness. Thus, the final decision is countersinking by a tool with hard-alloy tips in a cantilever basing configurations.



pic.1. Selection of technological operation for producing a cylindrical hole.

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THE PROJECT EVALUATION OF IC RELIABILITY AND RADIATION RESISTANCE

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The article discusses estimation of the probability of failure-free operation of spacecraft electronic systems under the influence of cosmic radiation. The article describes characteristics of ionizing radiation and the techniques for calculating the cumulative dose and probability of catastrophic failure. Main steps for the formation of the integrated circuit failure rate model under the low-intensity radiation exposure are illustrated.

Keywords: electronic systems, reliability, radiation influence

INTRODUCTION

Spacecraft electronic systems are exposed to various damaging factors during their operation in space. Major factors capable of damaging the electronic systems are: ionizing radiation, cosmic plasma, thermal radiation of the sun and planets, weightlessness, micrometeorites, cosmic vacuum, and closed volume of the surroundings.

Ionizing radiation consist of primary charged particles — heavy charged particles (protons, neutrons and ions), and secondary nuclear particles — products of nuclear reactions associated with the primary particles. The main ionizing radiation effects on the electronic systems are associated with ionization and nuclear energy losses of primary and secondary particles in the active and passive areas of semiconductors and integrated circuits (IC). There are two basic mechanisms of energy transfer from radiation to matter: ionization and substitution of atoms that cause degradation effects in the electronic systems. Depending on which type of mechanism dominates, subsequent parametric (or less frequently - functional) component failure may be reversible — relaxation phenomenon (dissipation of the charge brought on by radiation). Particles of higher energies lead to single event effects (SEE) — soft errors (recoverable) or herd errors (non recoverable). Hard errors concern Single Event Burnout (SEB) in power MOS, IGBT or power bipolar transistors, dielectric breakdown in gates (SEGR) or in capacitors, microdose-induced threshold voltage variation in MOS transistors. In bulk CMOS technology, PNPN parasitic structures may be triggered giving a Single Event Latch-up (SEL). SEL is associated with a strong increase of power supply current. SEL can be destructive by overheating of the structure and localized metal fusion, so it also can be considered as a hard error. A SEL needs a power cycle to be deactivated.

In addition the following may occur: change the transparency of optical media (radiation staining and/or cracking of optical glass), photonic noise in optoelectronic equipment due to radio-nuclear and cosmic radiation effects in optical components, breakdown and cracking of insulating materials due to electrification of dielectrics and radiation-induced chemical reactions, reduction of power supply sources due to the degradation of solar panels, etc.

1. RADIATION ENVIRONMENT MODEL

Electronic system is influenced by many different factors, each may cause a malfunction or failure of entire system.

The main sources of ionizing radiation in space are:

- Electrons and protons from natural radiation belts;
- Solar cosmic rays;
- Galactic cosmic rays.

Models describing the radiation environment, tend to be based on the following assumptions:

- Particle flows are omni-directional (isotropic);
- Orbital integration is presented for different heights and angles of incedent;
- Data on the spatial distribution of the charged particles are usually presented in the (L, B)-coordinates (L - orbit height normalized to the radius of the Earth; B - magnetic field);
- Given fluence φ (> E) [cm-2s-1], which is the rate of change of the fluence at all energies above the threshold energy E;
- Given the differential flux density φ (E) [cm-2s-1 MeV-1], which is a rate of change in the fluence dependent on the particle energy for a certain level of energy;
- Models correspond to certain periods of time and, therefore, refer to the conditions of the solar minimum or solar maximum.

Currently there are two accepted models - AE-8 (AE-8min, AE-8max) and AP-8 (AP-8min, AP-8max), which describe the distribution of electrons and protons for minimum and maximum solar activity. These models are the spatial distributions of electrons with energies of 0.1-10 MeV and protons with energies 0.1-400 MeV, respectively.

Such characteristics of solar cosmic rays as streams of charged particles and energy spectra vary greatly from flash to flash. Ions of heavier elements that make up the solar cosmic rays generally do not contribute substantially to the total amount of absorbed dose. However, they can cause malfunctions and failures due to the effects of individual nuclear particles. In assessing these effects it is necessary to use integral energy spectra of protons and spectra of linear energy transfer (LET) of ions.

Despite the fact that, traditionally, it is assumed that the accumulation of dose occurs uniformly (irradiation intensity is constant), there is a large range in the dose intensity, mainly due to the period of the solar cycle and other characteristics of space weather [1, 2].

2. METHOD OF PREDICTING THE RELIABILITY OF ELECTRONIC SYSTEMS WHEN EXPOSED TO IONIZING RADIATION

It is customary to consider the following two related issues separately: ensuring reliability of electronic and software systems and radiation resistance of electronic systems. Under conditions of a long-term space mission, radiation exposure of electronic systems has damaging effects on thermal and electric modes of electronic components and output characteristics of the electronic system. As a result, the problem of "radiation safety", as of yet, has not been fully resolved because of the lack of reliable methods and the appropriate methodological and normative support.

Existing standard documents provide a separate evaluation of the reliability and radiation resistance, as if they were two independent indicators of electronic systems quality. Reliability of electronic components for the current technical conditions is characterized by failure rate. Radiation resistance parameters of electronic components is given in the specification and corresponds to the maximum dose of radiation exposure after which the electronic component parameters remain within the limits of technical terms. Measure of resistance of electronic components to the effects of low-intensity cosmic radiation is the safety

factor, defined as the ratio of the total ionizing dose (TID) and dose electronic component had gained during spacecraft active lifetime.

When ionizing CMOS IC charge point defects of silicon oxide and partly charging major technological defects occurs. Under conditions of low-intensity radiation diffusion processes of natural aging and radiation defect formation become influenced each other and enhance the degradation of the electrical parameters of IC in general.

According to the guidance document [3], resulting failures in an IC can be divided into two classes:

- Failures of the 1st kind - direct radiation failures arising from exposure to ionizing radiation;
- Failures of the 2nd kind - random IC failures when tested on reliability due to degradation processes, which can be affected (or not affected) ionizing forcing.

Applying electronic components of “Space” quality level almost completely eliminate the contribution of the 1st kind failures in the total number of failures. However, for well known reasons, in electronic systems ICs of “commercial" quality level are widely used, which have a relatively low resistance to ionizing radiation. This increases the likelihood of failures during their operation.

IC failure probability is calculated as:

$$Q(t_{LT}) = 1 - P(t_{LT}),$$

where: $Q(t_{LT})$ - the IC probability of failure; $P(t_{LT})$ – the probability of failure-free operation, estimated by the equation:

$$P(t_{LT}) = P_1(t_{LT}) \cdot P_2(t_{LT}) \cdot P_3,$$

where: $P_1(t_{LT})$ - the probability of failure-free operation under the low-intensity irradiation; $P_2(t_{LT})$ - the probability of failure-free operation in the absence of exposure to cosmic radiation; P_3 - the probability of failure-free operating under the impact of single nuclear particles; t_{LT} - active lifetime.

Failure probability under the low-intensity irradiation Q_2 is estimated by the equation:

$$Q_2(t_{LT}) = 1 - P_1(t_{LT}) = 1 - e^{-\lambda_{rel} \cdot t_{LT}},$$

where: λ_{rel} - the failure rate in the absence of exposure to radiation; t_{LT} - active lifetime.

The IC probability of failure due to the SEE is estimated by the equation [3]:

$$Q_3 = 1 - P_3 = \exp(-\nu \cdot t_w),$$

where: ν - frequency of IC probability failures due SEE; t_w - the time of IC operating mode.

The frequency of IC probability failures due SEE is estimated by the equation:

$$\nu = \int_{L0}^{Lmax} \sigma(L) \cdot \varphi_{\text{ТЗЧ}}(L) dL + \int_{E0}^{Emax} \sigma(E) \cdot \varphi_p(E) dE,$$

where: σ (L), σ (E) - the cross-sections of the single effects LET of the charged heavy particles and the protons energy, respectively.

Thus, to use the model to estimate the probability of IC failure we need to estimate the contribution of low-intensity radiation to the failures rate.

Since the failures of the 1st kind are not connected with the internal mechanisms of failure formation in IC, they do not depend on time, in other words they depend only on the probability that IC accumulate the limit dose - D_{TID}. Therefore, the possibility to accumulate

limit dose may be presented as a function of a constant distribution of the sensitivity of IC to ionizing radiation. Radiation intensity is assumed constant.

Thereby draw a parallel between failures IC caused by exposure to ionizing radiation, and failures due to electrostatic discharge (ESD) may be denoted. This allows one to use a method of forming a model failure rate for CMOS IC [4], according to which the probability of failure-free operation is:

$$Q_1 = \int_0^{t_{LT}} f(D_{TID}) = \int_0^{t_{LT}} \frac{C}{\sigma(D_{TID})\cdot\sqrt{2\cdot\pi}} \cdot exp\left(\frac{\left(\frac{D_D - M(D_{TID})}{\sigma(D_{TID})}\right)^2}{2}\right),$$

where: $f(D_{TID})$ – the probability density of failures (fig. 1); $M(D_{TID})$ - the mathematical expectation level of radiation resistance; $\sigma(D_{TID})$ - standard deviation; D_D – actually accumulated dose; C – the normalizing factor.

$$C = \frac{1}{F(D_{TID.max}) - F(D_{TID.min})},$$

where: $F(D_{TID.max})$, $F(D_{TID.min})$ - the values of the normal distribution function.

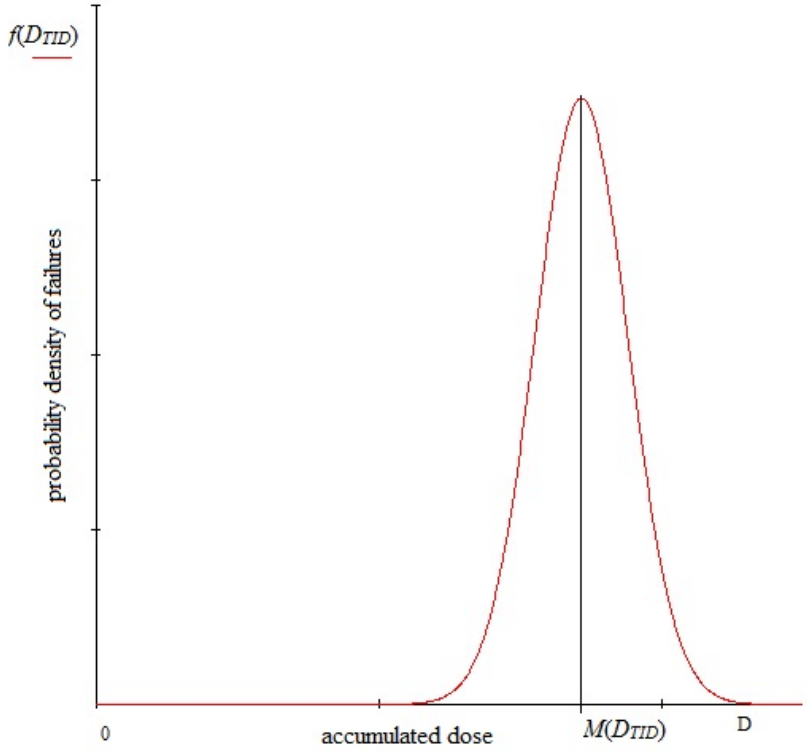

Fig. 1. Schematic graph of the probability density of failures

However, to estimate only the reliability is not enough to justify the possibility of using IC in terms of exposure to cosmic radiation.

Since IC correspond to the products of general purpose type I, it is characterized by continuous long-term use, unrecoverable, maintenance-free, which is a transition in the limit state leads to disastrous consequences, fraying, aging during storage.

For such products the following reliability indices are normalized:

- Failure rate;
- Average resource;
- Medium period of the conservation.

That is necessary to determine the IC minimum time to failure (MTTF) T_{MTTF}.

IC limit state criteria, according to [5], is formulated as "Increasing failure rate above the permissible level λ_{max}».

The value λ_{max} can be obtained by knowing the values of Q_1 and t_{LT} from equation:

$$1 - Q_1 = e^{-\lambda_{max} \cdot t_{LT}}.$$

Hence:

$$\lambda_{max} = -\frac{\ln(1-Q_1)}{t_{LT}}.$$

To evaluate T_{MTTF} the methodology described in [6] for the prediction of reliability and durability is used. Also suitable probabilistic and physical failure models recommended in [6] are used.

According to [4], the distribution function of time to failure IC is an α-distribution:

$$f(t) = \frac{C \cdot \beta}{t^2 \cdot \sqrt{2 \cdot \pi}} \cdot e^{-\frac{\left(\frac{\beta}{t} - \alpha\right)^2}{2}},$$

where: α, β – distribution parameters.

Parameter α – the relative rate of change of a characteristic parameter (uniformity coefficient determines the rate of change of the parameter)

$$\alpha = \frac{D_D}{\sigma(D_{TID})}.$$

Parameter β - relative reserve of durability:

$$\beta = \frac{M(D_{TID}) \cdot t_{LT}}{\sigma(D_{TID})}.$$

When using this model, the value T_{MTTF} equal to electronic equipment operating time t, in which the density distribution $f(t) \approx \lambda(t)$ first reaches a critical value $f_{critical}(t = T_{MMTF}) \approx \lambda_{max}$ (fig. 2.) [3]. Then the value T_{MTTF} can be found from the equation:

$$\lambda_{MAX} = \frac{C \cdot \beta}{T_{\text{м.н.}}^2 \cdot \sqrt{2 \cdot \pi}} \cdot e^{-\frac{\left(\frac{\beta}{T_{\text{м.н.}}} - \alpha\right)^2}{2}},$$

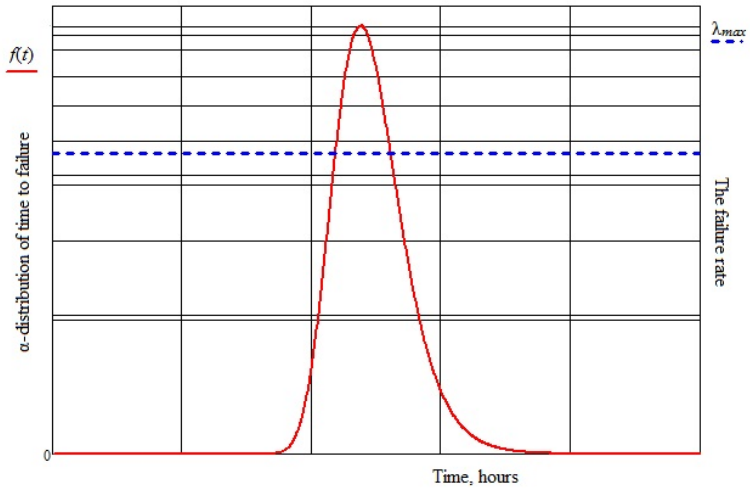

Fig. 2. Schematic graph of α-distribution of time to failure and failure rate

Estimation of the effect of radiation on the probability of failure-free operation of IC can be calculated by values P1(t) and P2(t), where:

$$P1(t) = e^{-\lambda_{rel} \cdot t},$$

$$P2(t) = e^{-(\lambda_{rel} + \lambda_{\max}) \cdot t},$$

CONCLUSION

Primarily research is aimed to analyze the reliability of electronic equipment of spacecraft considering the influence of ionizing radiation. At the given stage the model was built to estimate the probability of failure at the impact of low-level radiation on the IC.

Based on the results of previous tests for radiation resistance model parameters were calculated – mathematical expectations, standard deviation, and the normalizing factor for CMOS IC. That allow approximately estimate the minimum time before failure.

In conclusion, it should again be noted that the coefficients of the model depend not only on the strength of IC, but also the characteristics of the orbit of the spacecraft [7], so it is necessary to assess the probability calculations for specific values of the height and angle of inclination.

In addition, to improve the accuracy of estimation of resistance IC, they should be divided by technological groups (analog, digital, memory chips, FPGAs, microprocessors, etc.) and for each of them to get the model parameters.

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METHOD OF PARALLEL INFORMATION PROCESSING FOR THE OPTICAL SWITCHBOARD

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The problem of developing a method of high-speed information processing in the optical switching systems is solved. This method will allow to increase information transfer speed in switching structure also won't demand the high-capacity optical buffer device and will allow to apply optical switchboards in high-performance computing systems and communication systems. The algorithm of search of free channels of the data, realized in the microcontroller is simulated.

1. Introduction

We can't present modern computer facilities, communication systems, managements and processing of signals without application of optical technologies. It is dictated by modern requirements: increase in information capacity of channels, speed of processing of messages and increase of reliability of communication systems.

Transformation of an optical signal in electric and back reduces information processing speed, however, the majority of network problems while is solved on the basis of electronic

components which limit speed and reliability of system as a whole. Optical switchboards didn't receive wide use because of a lack of the optical decision which consists in lack of high-capacity buffer optical memory. [1] For buffering light signal are apply so-called delay lines which consist of specially punched silicon, as a rule. But such devices are bulky and expensive to their mass application for creation of new generation chips. Besides the sizes of existing optical buffer devices are insufficient for data processing without loss and they aren't intended for long storage of information because of attenuation of an optical signal. [2]

Therefore the problem appears to develop a method of high-speed information processing in the optical switching systems (SS) which will allow to increase information transfer speed in switching structure also won't demand the high-capacity optical buffer device and will allow to apply optical switchboards in high-performance computing systems and communication systems.

2. The methods of the optical switchboard management

The method of management has a great impact on structure of SS. Management of switching system is the complex of measures, necessary for their realization in structure of any network and maintenance of functioning of this network.

All SS can be divided into systems with the centralized or decentralized control depending on the principles of control.

The SS control is transfer of all its elements to certain states for establishment of demanded connection. If a switching element of system is the key, then it can be in two states – is closed and opened. It is necessary to establish in a demanded state everything or part of switching elements for connection installation between an entrance and an exit of the optical switchboard. This process is describe by some algorithm. The systems with the centralized control have a uniform central control unit which operates work all systems. The systems with the decentralized control have a set of local control units at each cell of switching. Information on necessary connection is transferred from a system entrance to switching elements consistently: from already adjusted element to another, yet to not adjusted. the control unit adjusts "the" switching element and transfers it to a control unit of the following switching element when it received this information.

Advantages of the SS with the centralized control of elements:

– the smallest complexity;
– fast implementation of control,

Shortcomings:

– lack of autonomy;
– existence of the big memory, which volume is defined by dimension of KS generally. [3]

The most part of the control unit (CU) is distributed on elements of switching system in case of the decentralized management of switching system. As a result of SS together with a control unit performs tuning on the basis of identical multiterminal networks. These multiterminal networks functionally unite some number of switching points and logical schemes of CU.

Systems with the decentralized control are more perspective from the point of view of their realization in the form of SBIS. Using enough simple local control units allows to use possibilities of integration of elements in a bigger measure and to improve characteristics of process of the SS control, as need to collect all information in the central CU and then to distribute it on all switching elements disappears. But such systems aren't favorable at a large number of entrances and witching cells, as big hardware expenses are required.

Advantages of the SS with the decentralized control:

– big autonomy;

– small number (in an ideal total absence) adjusting tires;
– lack of external memory for storage of adjusting information. [4]

The main disadvantage SS with the decentralized control of elements is the large number of operating tires.

We can consider optical switchboards with the centralized control. As the actuation device it can be used to use the microcontroller.

If the SS has 2048 inputs and 2048 outputs, and must consist of five cascades, the input and the output cascades of the system will have 128 blocks with dimensions of 16x64 and 64x16 correspondingly. The second and the fourth cascades will consist of 64 switching blocks with dimensions of 128x128. The intermediate cascade of the system consists of 256 blocks with dimensions of 128x128.The controllers (c) are connected to the outputs of SS, they are all connected by the basic bus-line, designed for the exchange of information, and are connected to the CU. (Fig. 1).

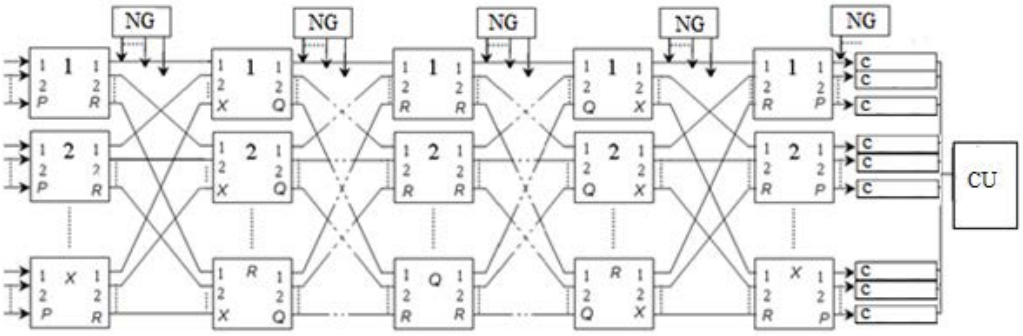

Fig. 1. The block diagram of the many-stage SS with the parallel identification of free channels

The CU provides functioning of the SS with the parallel identification of the data channels. The automated device with the unconditional logic can be chosen as a control device. Name Generator (NG) is a device that allows at some time to supply to the appropriate input of the commutation cell the name of the output line of the switching block, to which this commutation cell is connected. [5]

3. The simulation of the parallel identification of free channels method

We will allow that optical SS works on a method of parallel identification of free channels of data [3]. The algorithm of parallel identification of channels of data against information transfer is presented in fig. 2.

The algorithm of search of free channels of the data, realized in the microcontroller, is written in language Si programming. This algorithm allows to find free channels given in multilink SS with odd number of cascades (the number of cascades is set at the beginning of the program). Entrance values of this algorithm are number of an entrance to SS and exit number. The algorithm analyzes free cells of switching and gives out the parallel identifier which contains numbers of exits from intermediate blocks of system. This identifier unambiguously defines a way through SS. If it is necessary to connect the 7th entrance to the 12th exit of system and at this SS has 5 cascades (three intermediate),then the program, gives out result in the form of numbers of switching blocks and exits from these blocks, having analyzed free ways.

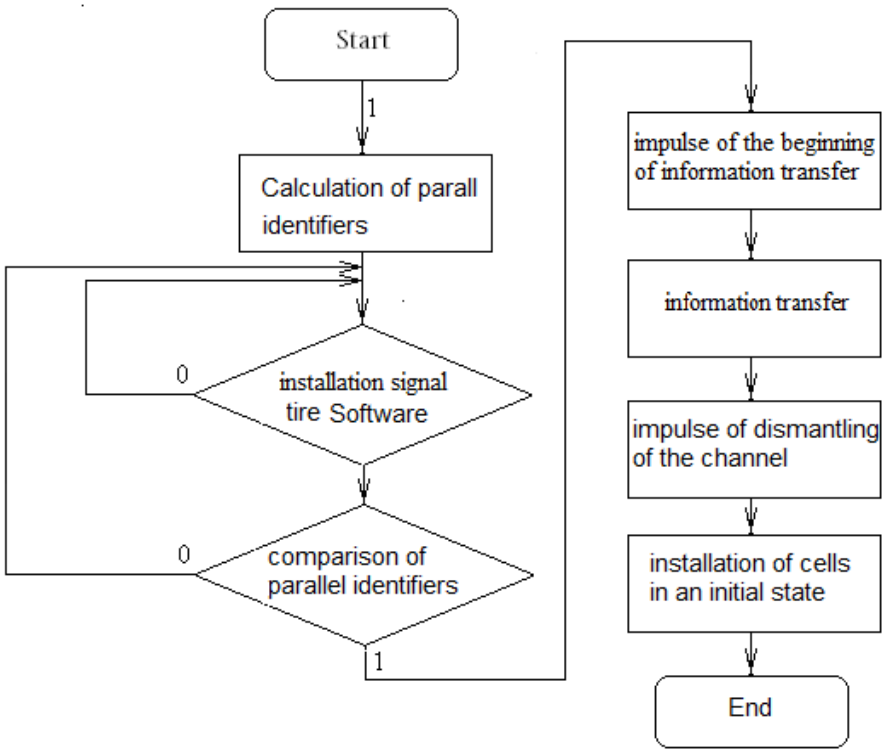

Fig. 2. The algorithm of parallel identification of channels of data against information transfer

The algorithm lays a way via all first blocks of system as SS isn't occupied yet. During the further work of algorithm the part of cells of switching will be occupied in information transfer and the way will be laid via other blocks of switching.

Further we will create model of the microcontroller and will check a correctness of work of algorithm by means of the logical analyzer.

Now there are some programs simulators of operation of the electronic devices, one of such – Proteus 7.2.

For check of correctness algorithm functioning of search free communication channels in the ATmega128 microcontroller we will carry out modeling of operation of the device in the program Proteus 7.2 simulator. This simulator allows to debug work of the scheme without assembly of the real device and to check operability of the offered algorithm (fig. 3).

The window appears at program start in which it is possible to choose type of the microcontroller and to connect the additional devices necessary for check of action of algorithm.

We choose the ATmega128 microcontroller. The first three entrances of the microcontroller are intended for record in a hexadecimal numeral system of numbers of an entrance and an exit of SS between which it is necessary to lay connection.

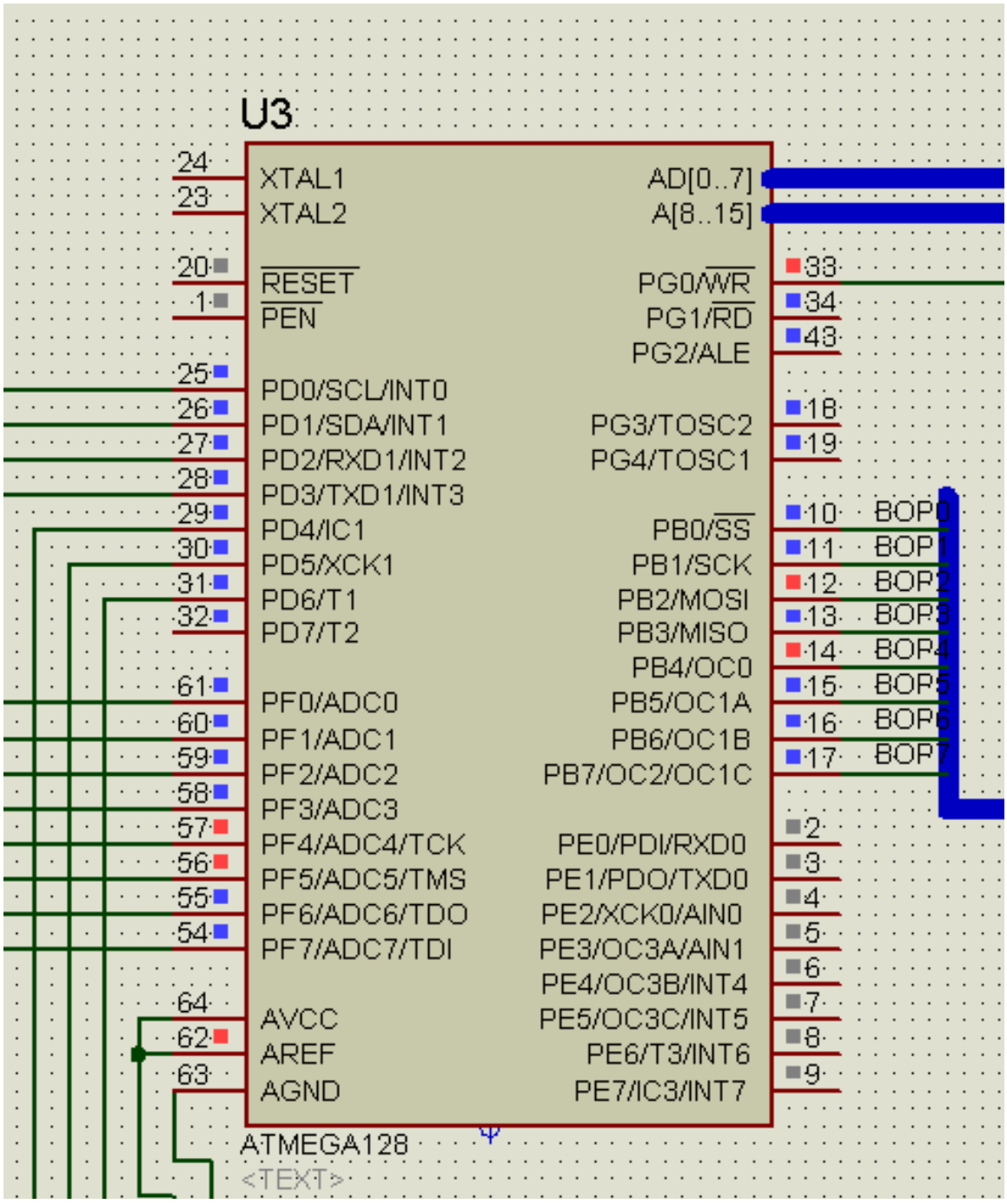

Fig.3. ATmega128 microcontroller

The following conclusion is intended for giving of an impulse of permission of the beginning of work of the program of search. The Gentbl impulse allows to update data files. This impulse in real SS moves from CU. PE exits is intended further for connection of the microcontroller to the general control unit (fig. 4).

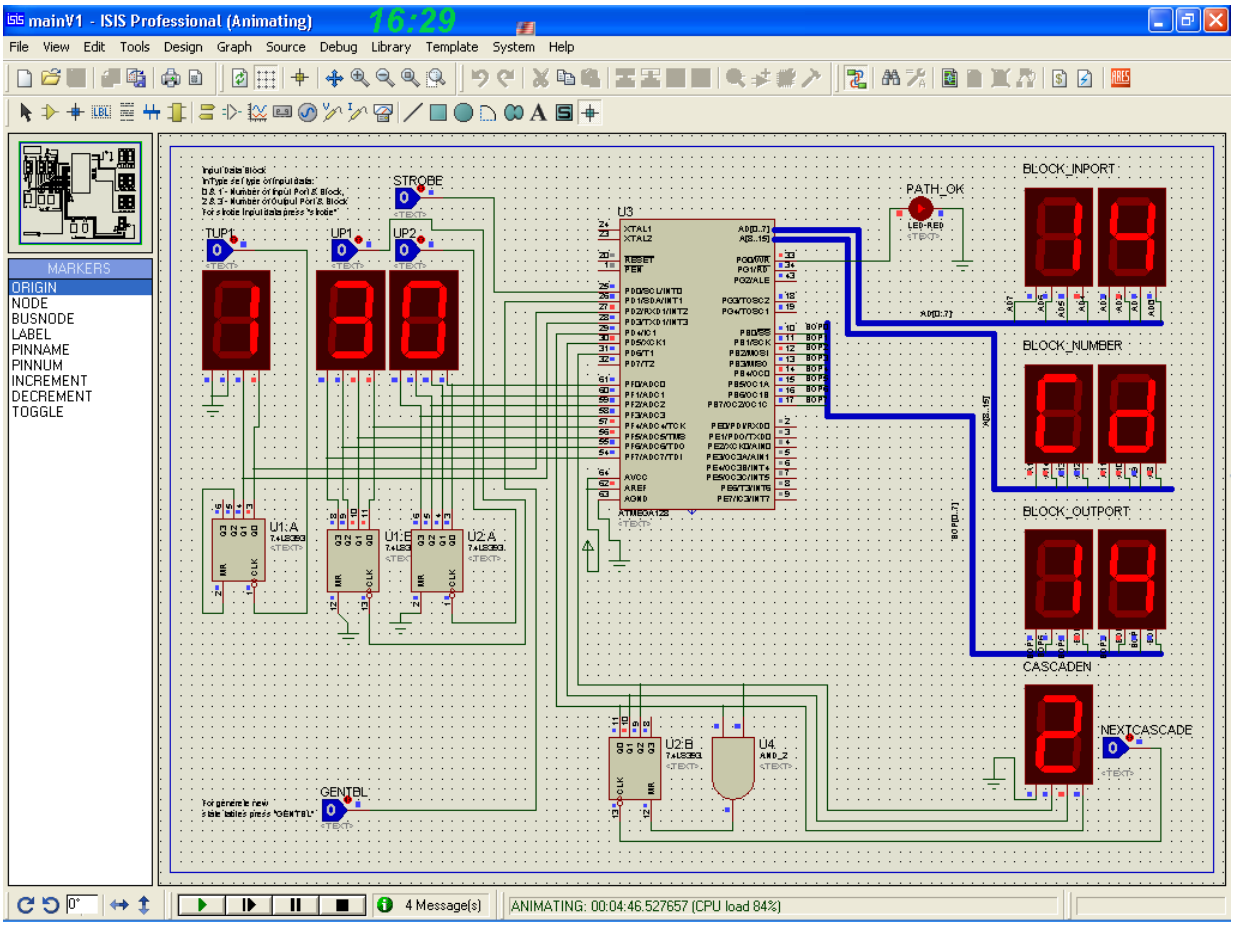

Fig.4. Imitating model of the microcontroller

The algorithm of operation of the microcontroller or search of free communication channels was written in the Si language and then by means of the compiler CodeVersionAVR V≥1.35 was transformed to the program for a controller insertion.

After a microcontroller insertion we connect indicators to exits and entrances of the device and we check a correctness of work of the program.

For insertion of the microcontroller we count number of switching blocks in each cascade at observance of criterion of Paul. We accept that SS has 2048 entrances and 2048 exits and consists of 5 links. Thus, entrance and output links of system have on 128 blocks dimension 16x64 and 64x16 respectively. The second and fourth link consist of 64 switching blocks dimension 128x128. The intermediate link of system has 256 switching blocks dimension 128x128.

When developing SS with other parameters minor changes are made to algorithm of search of free channels of data. [6]

The second and third indicator specify (in a hexadecimal numeral system), what entrance and what block of the entrance cascade with what exit and what block of the output cascade it is necessary to connect. The first indicator in figures from 0 to 3 defines type of the data issued on these indicators: 0 – number of an entrance of the block of the entrance cascade, 1 – number of this block. 2 – exit number from the block of the output cascade, 3 – number of this block.

The microcontroller gives out results of work serially on cascades. Number of the cascade is specified on the bottom indicator. The top indicator shows number of an entrance to the switching block of the chosen cascade, the average indicator shows number of this switching block, the bottom indicator specifies an exit from the switching block (fig. 5).

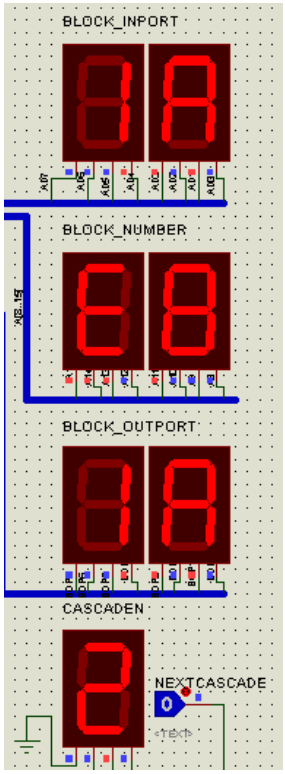

Fig.5. Operation of the microcontroller

For example, in figure 3 it is shown that in the second cascade are involved 1A an entrance to E8 the switching block and 1A an exit from this block. After transfer to a decimal numeral system we will receive the 26th entrance to 232 switching block and the 26th exit from this block.

In fig. 6 graphic dependences of probability of expectation of a package are presented to turns from package length at number of busy exits - 80% for SS with the consecutive principle of establishment of connections, SS with a single mode of switching and SS with the parallel principle of establishment of connections. Modeling was carried out in specially developed program. [7] Results of modeling are presented in table 1.

Tabl.1 Average values of probability of expectation of packages in turn

Package length	Size of the buffer, cell	Size of the buffer, cell	Size of the buffer, cell
15	0,35	0,74	0,67
30	0,54	0,82	0,77
45	0,71	0,88	0,86
60	0,72	0,89	0,86

The error of modeling of 5% is displayed on the schedules.

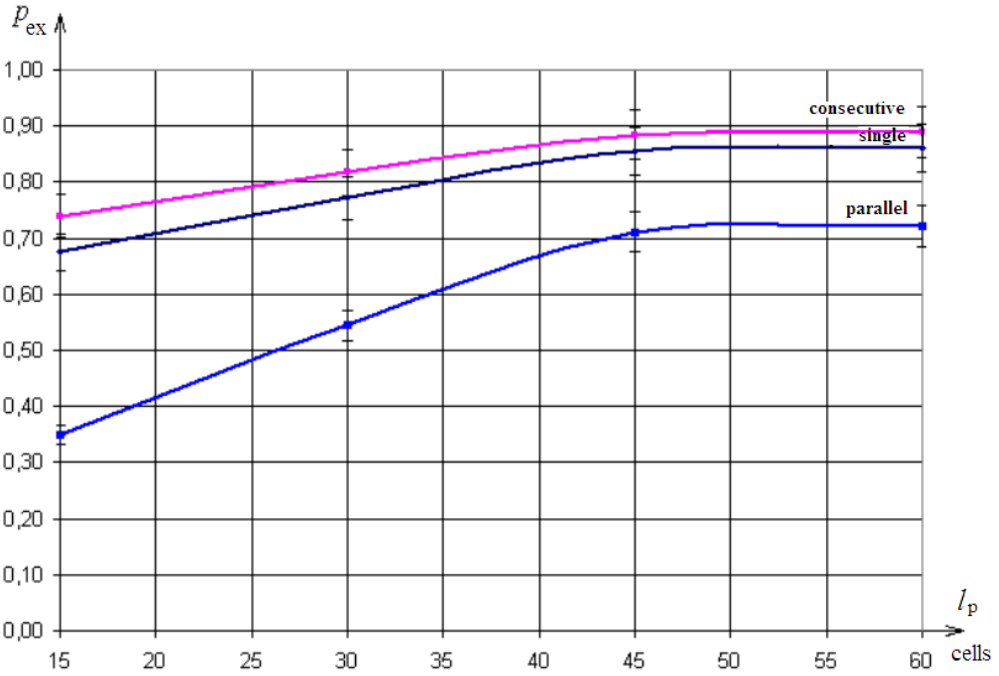

Fig.6. Dependence of probability of expectation of a package in turn from package length at number of busy exits of 80%

Analyzing the constructed schedules it is possible to draw a conclusion that with a length of package $l_p = 60$ cells the probability of expectation of a package in turn when using a method of parallel processing is 20% less in comparison with SS using consecutive algorithm of establishment of connections, and 18% less in comparison with SS working in a single mode of switching.

According to a single mode of switching of SS functions in three stages: first stage - scheme control; the second stage - information transfer; third stage dismantling of communication channels. At a stage of process of establishment of connections search of free intermediate ways is carried out, at the second stage there is a transfer of useful information on the adjusted communication channels. Thus the new stage of establishment of connections can begin only after the end of process of transfer by all devices. This mode is acceptable not for all systems of telecommunications, but only for those cases where the moments of receipt of packages aren't casual and known in advance.

Therefore, using of a method of parallel information processing in SS allows to serve arriving packages quicker that is positive property of system in case the traffic sensitive to delays is transferred, and also allows to lower significantly requirements to the extent of buffer memory of the optical switchboard.

4. Conclusion

In this article the method of parallel information processing for optical KS is offered. The algorithm of work of optical switching system on the basis of a method of parallel identification of free channels of data is considered. It is offered to use the ATmega128 microcontroller as CU. The imitating model of search of free communication channels is developed. In the Proteus 7.2 program the ATmega128 microcontroller of AVR family of Atmel firm is chosen, and operability of algorithm of parallel identification of free channels of data is checked. This method of high-speed information processing in optical SS allows to increase information transfer speed in switching structure, and doesn't demand the high-capacity optical buffer device that will allow to apply optical switchboards in high-performance computing systems and communication systems.

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INFORMATION AND TECHNOLOGIC PROVISION OF THE AUTOMATED SUPERVISORY CONTROL SYSTEM FOR DISTRIBUTED HOUSING AND PUBLIC UTILITIES

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The article deals with the question of creating an automated system of supervisory control of distributed energy resources, as well as organizing the information exchange between the equipment of separate functional levels by the example of the implemented ASCS (Automated supervisory control system) of distributed energy resources of OJSC “Kmaproyektzhilstroy” in Stary Oskol. The special attention is paid to the solution of problems connected with unification of protocols and integration into the system of the diverse equipment of the ASCS bottom functional level.

Keywords: ASCS, energy efficiency, information exchange, protocol, distributed energy resources.

At the enterprise of any level complying with all current trends of development of technologies, the main objective of modernization is the increase of energy efficiency and power safety level. One of the best technological actions that can help achieving the required performance for energy efficiency is the use of information systems, which allow:

1. control the distributed energy resources centrally;

2. collect, transmit and display the operational information about the parameters of the technological mode of the enterprise's operation, followed by analysis of the state of control objects in real time;

3. carry out the choice of optimum operating modes of the enterprise objects;

4. collect, transfer and display the non-operative technological information on the account and the quality control of functioning given from microprocessor devices of relay protection and anti-emergency automatic equipment and auxiliary systems (fire extinguishing, the security alarm system, etc.);

5. optimize expenses on the objects service;

6. create and fill (update) a database of significant parameters for an assessment of quality of functioning of objects of the enterprise;

7. provide the multiuser enterprise control system for the exception of the possible contingency situations connected with random errors of operators and etc.

As an example of the information system combining all the above described properties, can serve the power effective automated supervisory control system (ASCS) of the distributed housing and communal services objects, implemented in Stary Oskol, Belgorod region of OJSC "KMAproektzhilstroy" [1]

An automated supervisory control system is territorially distributed multilevel information and measuring central-station real time control system and is intended for control and management of technological processes and equipment at the objects of the industrial enterprises and city networks of housing and communal services.

In the information structure of ASCS we can single out the three functional levels:

- data collection and acquisition systems (DCA) – the bottom and average level according to ASCS;
- operational information operating complex of the control center – the top level of ASCS

The ASCS bottom functional level represents autonomous boiler rooms with several coppers, carrying out a heat supply and hot water supply of inhabited residential districts; the individual thermal points (ITP), the sewer pump stations (SPS), sensors and actuators which are used in local control systems of these objects.

At the development and deployment of ASCS of an enterprise there occurs a problem connected with use of the diverse equipment of the bottom functional level and various extent of automation of separate objects (fig. 1.) [2]:

1. The manually operated elevator components and ITP, as a rule, do not have communication interfaces to combine objects into a single enterprise network. In this case, the problem is solved by installing additional sensors that determine the state of an object (primary sensors of temperature, pressure, level, etc.).

2. Autonomous boiler houses with boilers having a control system, as a rule, have in their structure a communication interface. When creating ASCS it is necessary to choose the appropriate communication controller providing the correct contact.

3. The sewage pumping station had in its construction the equipment, which gave discrete signals about it condition. Hence, for this object it was necessary to install the equipment processing discrete signals and transforming them to the corresponding signal, transmitted to ASCS.

The average level of ASCS serves for the unification of heterogeneous signals and their subsequent transfer to the top level in a correct unified form to ensure the right processing of the information. The following equipment was applied for this purpose:

1. For processing the output signal from the control panel of the autonomous boiler room coppers, transferred under the RS-485 protocol, there is used a communication controller

of the i-7188EAX series, carrying out the transformation and transfer of an input signal by the Ethernet protocol.

2. When processing the output signals of the primary sensors of ITP there was used an analog input module OWEN MBA-8, receiving the analog signals of the form: 800 .. 2000 ohms, TCM 4 .. 20 mA, and the output is a signal transmitted via Ethernet.

3. For processing the output signal from pumping stations there is used an input-output module of series i-7060DIO.

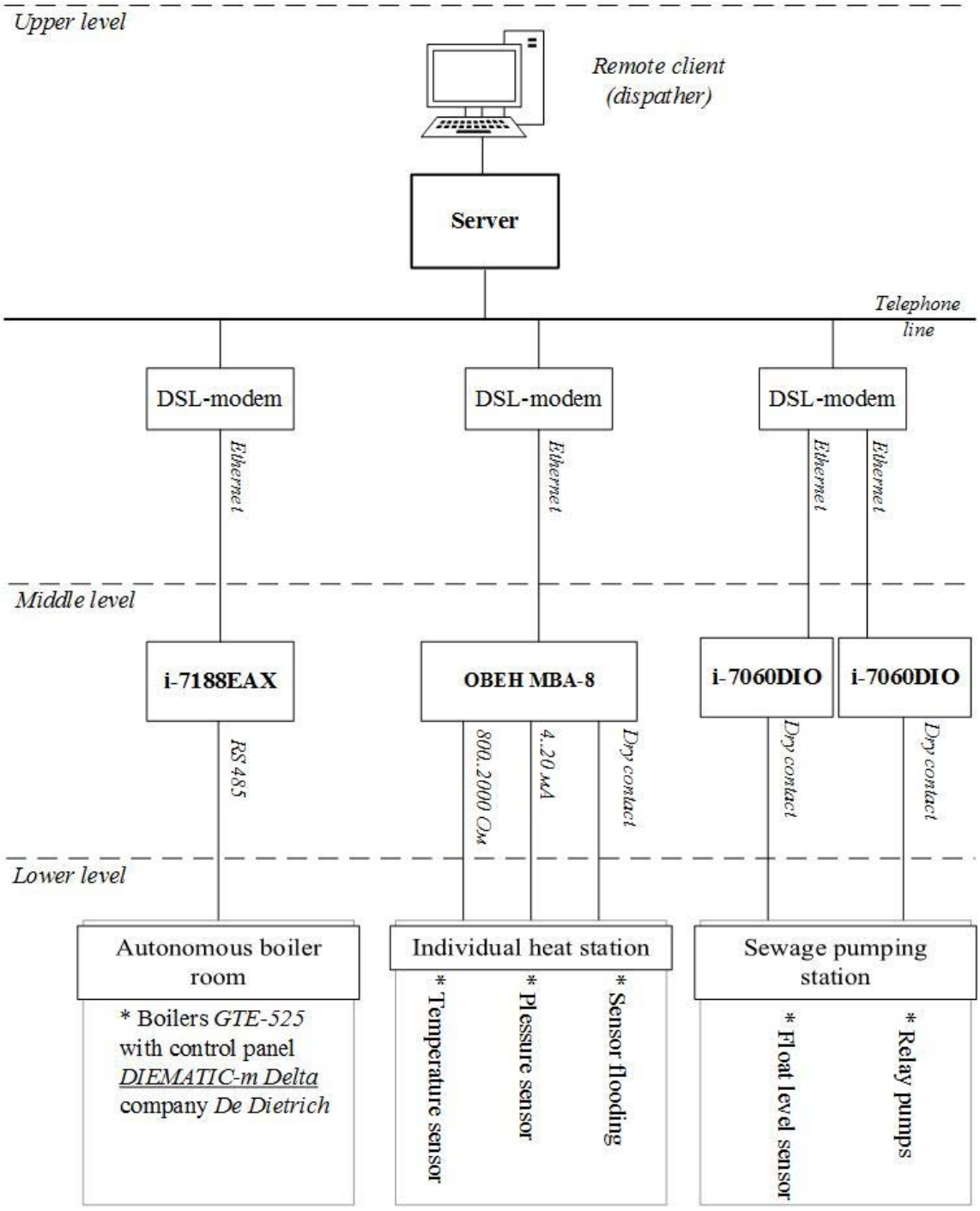


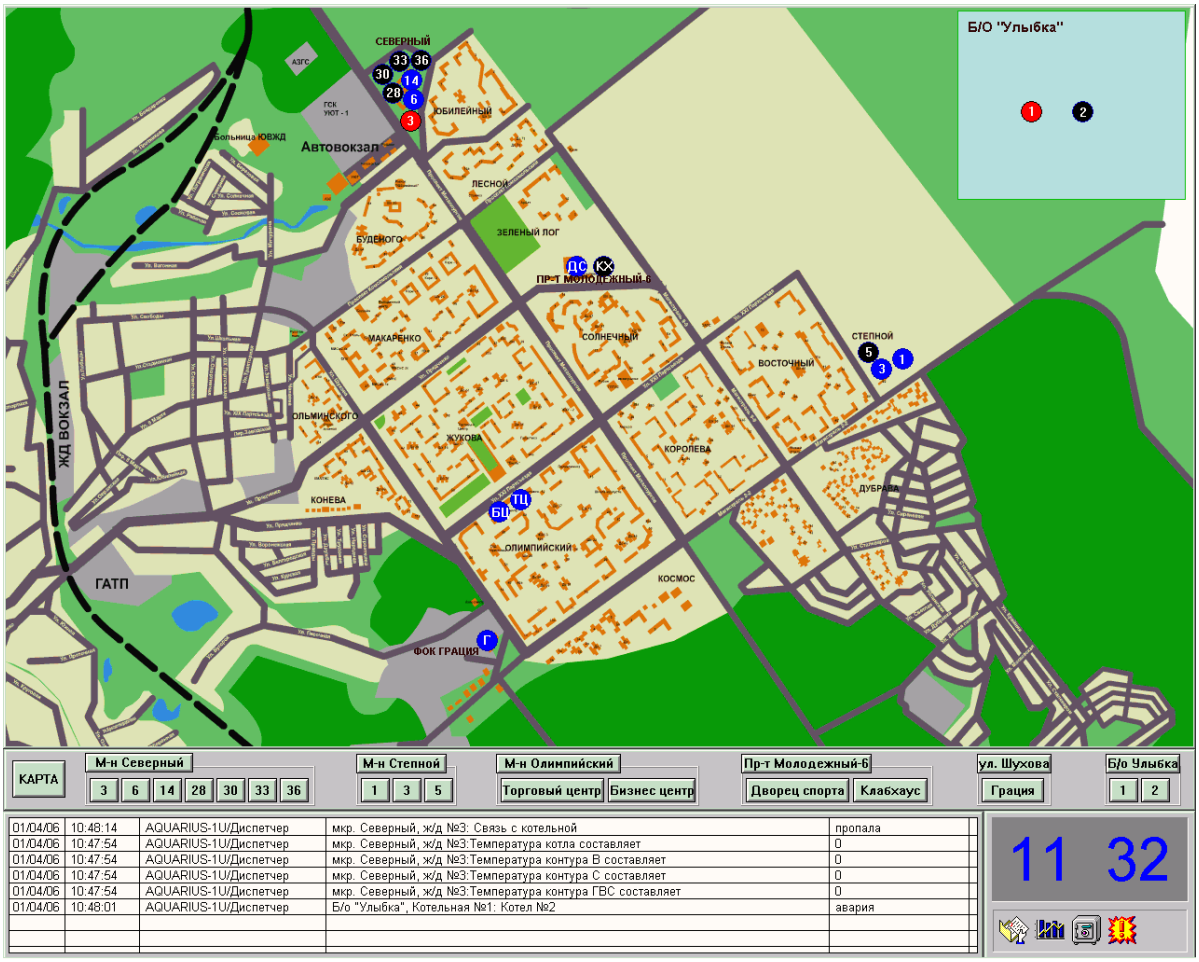
Fig. 1. Model of ASCS of the distributed objects of housing and public utilities

After ensuring the transformation of the objects' output signals to the unified form there occurs a problem of territorial remoteness of objects from each other, caused by the

geographical arrangement of the enterprise branches. For the solution of this problem it is necessary to create the communication lines providing reliable information transfer, complying with speed performance qualities, necessary for correct processing.

Within the city precincts this problem can be solved, using the city telephone network. Then the DSL modems, providing the correct transformation of a signal, are necessary for transforming the output unified signals. If the objects are located rather far from each other, this problem can be solved, using the technology of GSM data transmission and capabilities of the Internet, as well as the fiber-optical communication lines between objects.

The hierarchical structure of ASCS implies the central-station control of the enterprise objects, as is provided at the top level. The concept of control center means the creation of an integral block, protected against contingency and emergency situations, and providing control and management of remote distributed enterprise objects. The integral server which carries out the poll and processing of the signals coming from the control objects is required for providing the functioning of control center. Due to visualization by means of SCADA (fig. 2, 3), the operator of control center gets access to the server and is able to trace and operate the remote enterprise objects, having full and actual information on functioning of all objects included into the system of dispatching control.



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01/04/06	10:47:54	AQUARIUS-1U/Диспетчер	мкр. Северный, ж/д №3:Температура контура ГВС составляет	0
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Fig. 2. The screen form of the dispatcher's automated working station

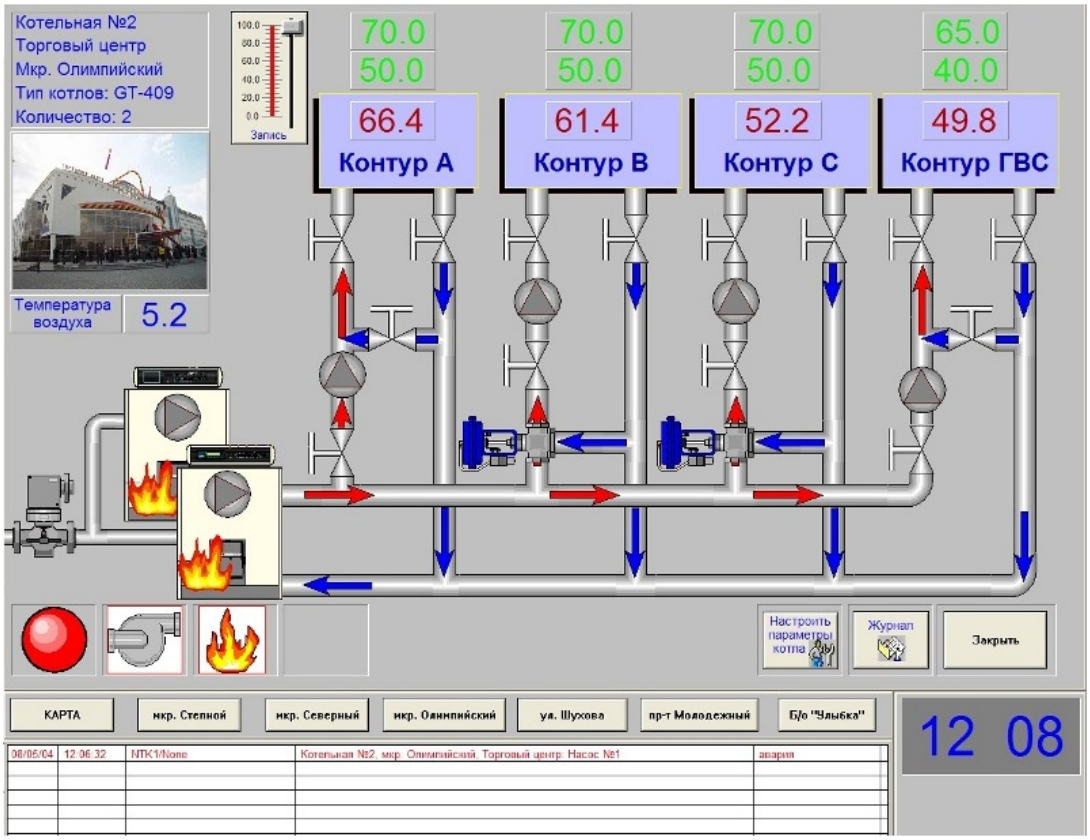

Fig. 3. The mimic diagram of the boiler house as part of ASCS of distributed energy resources.

Thus, the above described information and technologic provision allows solving the problems of synthesis, implementation and operability of the automated system of supervisory control of the remote distributed enterprise objects of various orientations. In the operating mode there is performed the batch exchange of information between all levels of the system, which allows providing the full functionality of all objects of the information system, specifying the optimum settings and operating modes of the central-station controlled equipment, and raising the level of energy efficiency and power safety of both separate technological objects, and the enterprise as a whole.

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POSITIONING SYSTEM WIRELESS MODULE ON THE MAIN PIPELINE

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A characteristic of an automated positioning system wireless modules - gas detectors, within a distributed wireless monitoring system for gas leaks from gas mains.

In the process of gas pipelines (MG) problem assessment of the environmental impact of leaks of pollutants, more gas - methane, resulting from industrial processes carried out during production and transportation of hydrocarbons. Timely detection of gas leaks can reduce the risk of accidents involving extensive material damage, and as a result increase the likelihood of smooth operation of all production facilities of the gas transportation system.

One of the methods [1] gas leak detection is the use of a distributed wireless monitoring system (RBSM) [2]. RBSM is based on different software and hardware and is a sensor network consisting of a plurality of spatially distributed wireless modules (BM) [3], established near the pipe (about 5-10 m), and at intervals along the tube (about 100 m) interconnecting the radio and transmitting information about gas leaks from MG from point to point through the relay. Under the BM should be understood controller with connected sensors for gas detection, wireless transmitter, power supply and means for autonomous existence.

To improve the efficiency of detection of gas leaks by RBSM on MG must produce more accurate alignment of the BM along the pipe with the following factors: the type of the underlying surface, the prevailing wind direction (wind rose), the distribution of the gas cloud, the presence of power lines; protected areas (such as parks, military installations), etc.

Automated System (AS) "Positioning BM" [4], allow us to analyze and consider the factors listed above and then calculating the BM ranking places on a certain stretch of the pipeline, display themselves BM, gas pipelines and weather on an electronic map, reporting on the results of the documentation of the system and the subsequent issuance of recommendations. AS consists of five subsystems, each of which has its own role.

Authorization subsystem - designed for passing user authentication procedures/authorization and give the user the rights to perform certain actions. Performs the functions of creating, editing and deleting user accounts.

Subsystem of the database (DB) - performs all operations related to access to the database, ensures the correct execution of the select queries to add, edit, or delete data from the database, performs the functions of checking the integrity of data entered in the database (Fig. 1) consisting of seven interrelated tables that store all the information necessary for the AS. When developing an application used database management system Microsoft SQL Server 2008.

Data processing subsystem - performs the functions of a coordinate positioning BM calculation under various user-selected factors affecting the distribution of the gas cloud, or excluding those with a subsequent call to the subsystem work with databases for entering coordinates BM database.

Subsystem help and assistance - provides the user with the AS background information tooltips, system messages, which will facilitate the work with the system.

O subsystem - is designed to display the results of the data on the screen in the form of graphs, tables, cartographic information.

As the external environment supports server "Weather Russia" from receiving data from weather stations, after which they are entered in the database, or the company's management, which will be installed speakers, giving instructions to the system operator to perform certain actions.

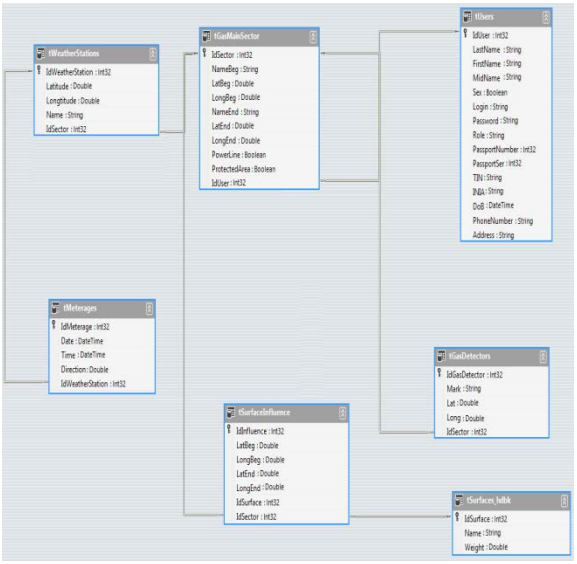

Fig. 1. The database schema

To create a system used application development environment Microsoft Visual Studio 2012, as well as programming languages and data manipulation, such as Visual C # and Transact SQL. Developed AU consists of 15 modules:

- FormMain - the main form of the system;
- FormOperatorMain - the main form of a user with a "Operator";
- FormAuthorization - user authorization in the system;
- FormGasDetectors - work (introduction characteristics) with gas detectors;
- FormGasMainSector - operation (add, delete, display, introduction of performance) with areas of MG;
- FormResults - location (positioning) gas detectors along the MG and display the trace on an electronic map;
- FormSurfaces - work with the types of surfaces;
- FormUser_Add - adding a new member;
- FormUser_ChangePassword - change/reset a user's password;
- FormUser_Edit - edit user data;
- Form_WeatherStation_Add - mapping and adding new weather station;
- FormWeatherStation_Meterages - preview, update data measurements from weather stations;
- FormWeatherStations - work (introduction characteristics) with weather stations;
- GetHash - obtaining the password hash using the method SHA256;
- MarkerManager - alignment, grouping markers on the map.

Fig. 2 shows the result of positioning BM, with explanatory characteristics (site name MG, prevailing wind direction, types of surfaces, the number of detectors, gas detectors location settings), submitted on an electronic map of the site MG, implemented by means of the AS, taking into account influencing factors. During operation of the system, the user can export the data in a document Microsoft Word, generate a report, select another site for the location of MG on it with the BM into account other factors, or to finish the work with the system.

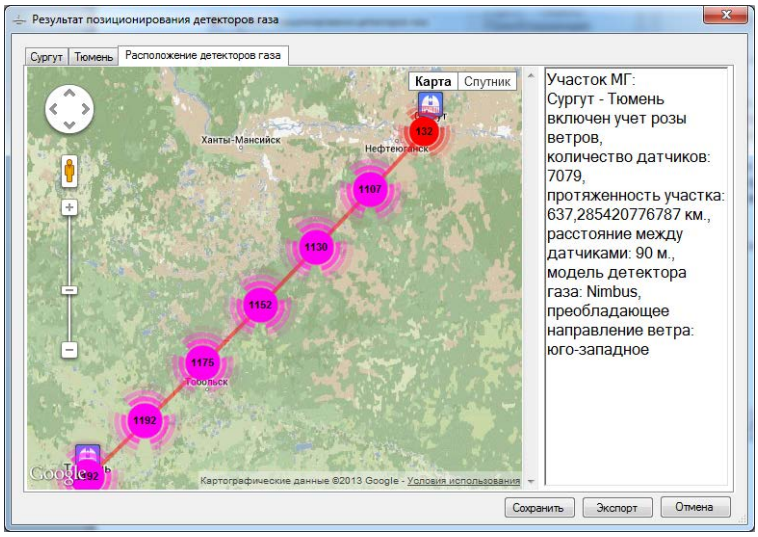

Fig. 2. Result of the system

As a result of the operation of this system will be reduced economic costs arising in case of emergencies, by reducing the time and improve the accuracy of detection of gas leakage at sites MG by BM.

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RESEARCH OF MANAGEMENT ALGORITHMS BY EFFICIENCY OF HEAT POWER OBJECTS FUNCTIONING

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Proposed criteria for the performance management function of the boiler unit, a steam turbine and power. Proposed software and hardware devices for measuring the performance of a boiler and a steam turbine. Propose an algorithm for adaptive performance management power unit software and hardware devices, adaptive control of the power unit, performance criteria, quality control processes, the identification algorithm the operating point.

Keywords: software and hardware devices, adaptive control of the power unit, performance criteria, quality control processes, the identification algorithm the operating point.

Modern means of automation allow you to control power units at cost commodity product, in this case, electricity. Indeed, Figure 1 shows the field dependence of the efficiency of the experimental data of the boiler, steam turbine and the power of an enterprise for the production of electricity from the main control action costly - natural gas consumption. Experimental data obtained by the passive data gathering and processing of least squares method is used. The processing of the experimental data obtained by the model of governance criteria as the current values of the **efficiency of the boiler**, which has the form:

$$Э_b(iT_S) = -0.025 \cdot G_g(iTs)^2 + 2.961\mathrm{G}_g(iTs) - 173.654 \quad (1)$$

where $G_g(iTs)$ – discrete values of the gas flow rate corresponding to the current readings at time Ts;

The current value of the **efficiency of the turbine**, which has the form:

$$Э_t(iT_S) = -0.014 \cdot G_{ss}(iTs)^2 + 3.385\mathrm{G}_{ss}(iTs) - 201.975 \quad (2)$$

where $G_{ss}(iTs)$ – discrete values of the superheated steam flow corresponding to the current readings at time Ts;

The equation for estimating the current values of the **efficiency of the unit** has the form:

$$Э_u(iT_S) = -0.0214 \cdot G_g(iTs)^2 + 3.841\mathrm{G}_g(iTs) - 190.021 \quad (3)$$

where $G_g(iTs)$ – discrete values of the gas flow rate corresponding to the current readings at time Ts;

Figure 1 shows that the maximum efficiency of power as the sum of the efficiencies of the boiler and turbine unit coincides with the minimal cost of electricity generated [5]. With a minimum of cost coincides with the maximum efficiency of the power unit. Therefore, the main objective of the indirect estimation of minimum cost, is to find the current position values of the gradient of the boiler and turbine gradient and change of control action so as to reach the maximum efficiency of the power unit (minimum cost). [8] This is possible only when the current value of the efficiency of the boiler (1) is in a negative gradient region, and the current value of the efficiency of the turbine (2) is in a positive gradient.

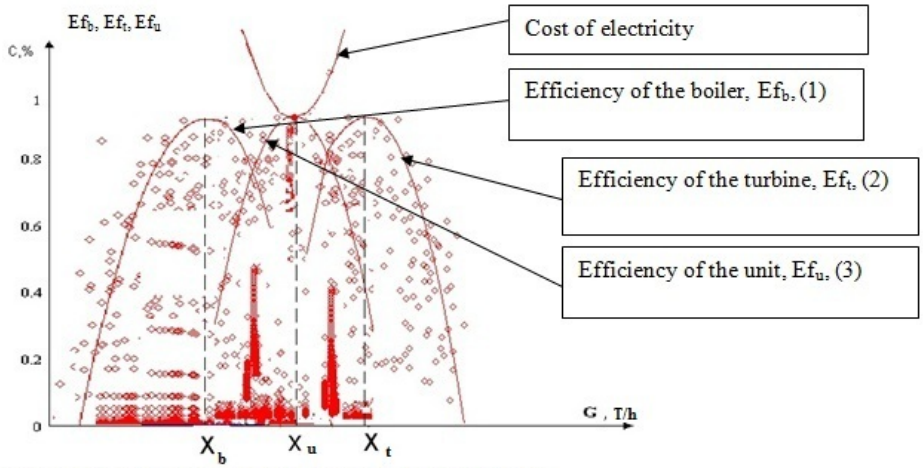

Figure 1 - Field experimental data, the efficiency of the unit.

Thus, knowing the model estimates the performance of individual equipment of power in the form of extreme dependency (1) and (2) allow us to go to the optimal management of energy by the maximum efficiency of the power unit (minimum cost of electricity produced).

Definition (indirect measurement) the current values of governance criteria (1) and (2) can be assigned to an information subsystem control system, supplying it with software and hardware devices that direct and indirect measurements of a variety of physical quantities calculated the current value of the efficiency of the equipment. The task of improving the management of energy-intensive technical systems is complicated by the large inertia of modern engineering systems. Therefore, the equation for the indirect measurement criteria for the management of technical systems necessarily have in its records a reference model of the control object in the form of dynamic characteristics of the control channel. This is necessary in order to give feedback to the control input to the time one measurement control criterion.

The basis of the hardware and software of the device for measuring the efficiency of the boiler is put dynamic model of the boiler unit test management [1,4], which has the form:

$$Э_b(iT_S) = \frac{Y_1(iT_S) \cdot Y_5(iT_S) \cdot \text{int}(Y_6(iT_S))}{\sum_{j=0}^{N} X_1(iT_S) h_{15}((j-i)T_S) \cdot \sum_{j=0}^{N} X_2(iT_S) h_{21}((j-i)T_S) \cdot \text{int}(Y_6(iT_S))} \quad (4)$$

where Y1(iTS) - current value of the flow of superheated steam ; Y5(iTS) - the current temperature of the superheated steam ; Y6(iTS) - The current pressure superheated steam ; X1(iTS) - the array of current values of fuel consumption ; X2(iTS) - the array of current values of water consumption ; h15(jTS) - elements of an array of weighting coefficients via the influence on the fuel consumption of the superheated steam temperature, h21(jTS) - the array of weighting coefficients via the influence of the feed water flow of superheated steam, intY6(iTS) - enthalpy of superheated steam at pressure superheated steam, N - length arrays software.

Instrument for measuring the effectiveness of the boiler (see Fig. 2) consists of the application package and the device robust stabilization of the measured parameters of the boiler unit. The apparatus consists of a stabilization control level in the drum of the boiler unit (unit 1), a reference model for a robust stabilization load (block 2), a reference model for a robust stabilizing intensity point (block 3), the superheated steam temperature control (block 4) and calculating the current efficiency values of the boiler (block 5). [6]

The device operates as follows. The sensor signal is fed to a level 1, which compares with the task and produced signal changes in flow of water in the block 2, which works on the reference model of the following form [1]:

$$W_{22} = \frac{1.18}{2.62 \cdot p^2 + 1.6 \cdot p + 1} \cdot e^{-0.67 \cdot p}$$

$$W_{25} = \frac{1}{2.89 \cdot p^2 + 2.5 \cdot p + 1} \cdot e^{-1.2 \cdot p} \quad (5)$$

The signal output block 2 is summed with the output of block 3 - regulating the intensity of boiling water and applied to the input block 5, which is a criterion for calculating the control (4). Block 3 operates on the reference model of the following form [1]:

$$W_{18} = \frac{0.059}{9.36 \cdot p^2 + 10.33 \cdot p + 1} \cdot e^{-15 \cdot p}$$

$$W_{15} = \frac{1.293}{2.55 \cdot p^2 + 2.18 \cdot p + 1} \cdot e^{-2 \cdot p} \quad (6)$$

In block 5 is supplied, also, the results of temperature control block 4, the superheated steam and other necessary direct measurements.

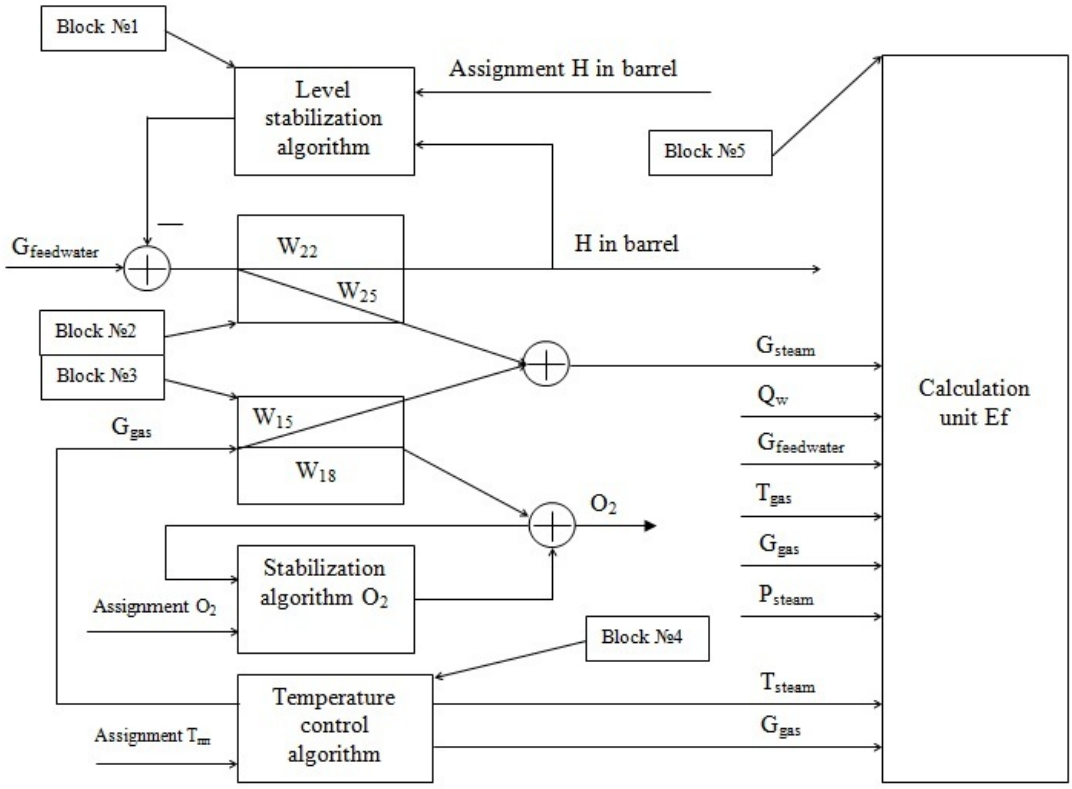

Figure 2 - Hardware-software device for measuring the efficiency of the boiler.

Figure 3 is a block diagram of a simulation of the instrument for measuring the efficiency of the boiler, which comprises a block 1 for implementing the reference pattern of the boiler and block 2 for implementing the control equation measurement criterion (4). Block 1 operates in accordance with a reference model of a boiler [1]:

$$W_{11} = \frac{0.23}{0.99 \cdot p + 1} \cdot e^{-1,6 \cdot p}$$

$$W_{15} = \frac{1.293}{2.55 \cdot p^2 + 2.18 \cdot p + 1} \cdot e^{-2 \cdot p} \qquad (7)$$

$$W_{25} = \frac{1}{2.89 \cdot p^2 + 2.5 \cdot p + 1} \cdot e^{-1.2 \cdot p}$$

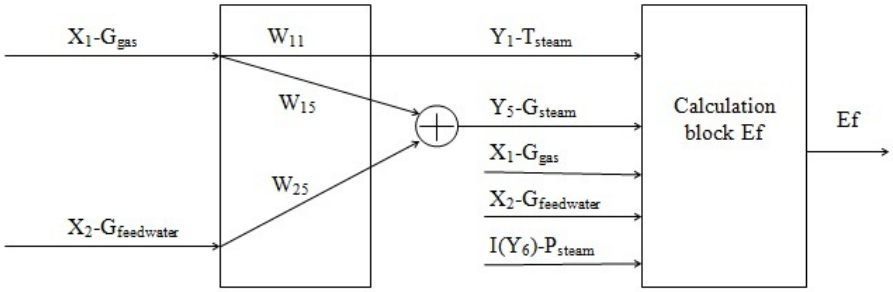

Figure 3 - Simulation scheme of the device for measuring the efficiency of the boiler.

Figure 4 shows the trend operator workstation, showing the change of the current value of the efficiency of the boiler.

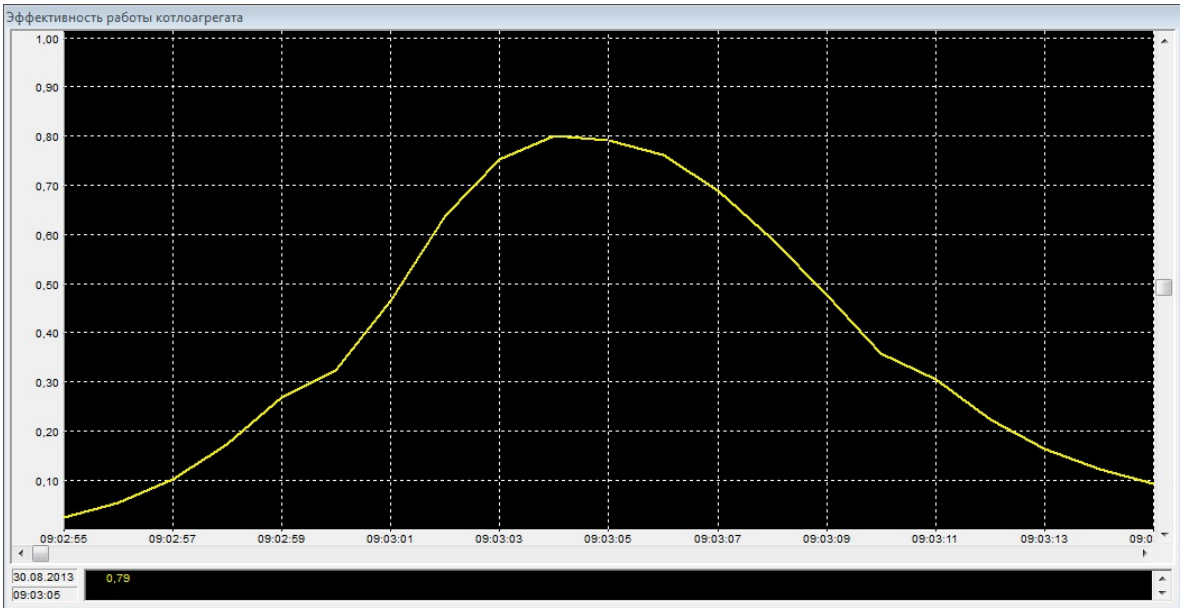

Figure 4 - Trace Mode window – $Ef_b(t)$.

Similarly, based on hardware and software of the device for measuring the performance of the turbine unit is put dynamic model of turbine unit control criterion [1], which has the form:

$$Э_t(iT_S) = \frac{W(iT_S)}{\sum_{j=0}^{N} X(iT_S) \cdot h_{11}((j-i)T_S)} \quad (8)$$

where X(iTs) - array of the actual values of flow of superheated steam, W(iTS) - current value of the active power turbine unit, h11(jTS) - an array of dynamic characteristics of turbine unit.

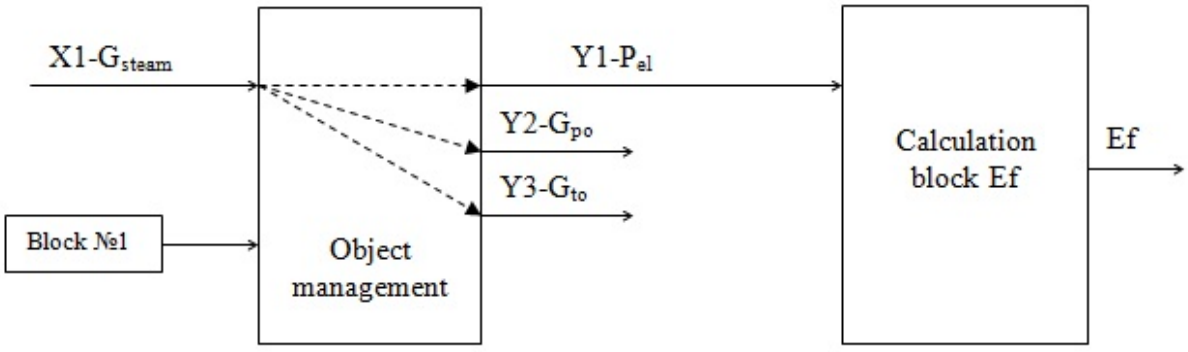

Figure 5 - Hardware-software tool for measuring the performance of turbine unit.

The device operates as follows. The signal from the flow sensor is fed to a pair of 1, where it is compared with the reference and the control signal is generated as a consequence of changing the active power turbine unit.

Figure 6 shows the trend of the operator workstation, showing a change in the current value of the efficiency of the turbine set.

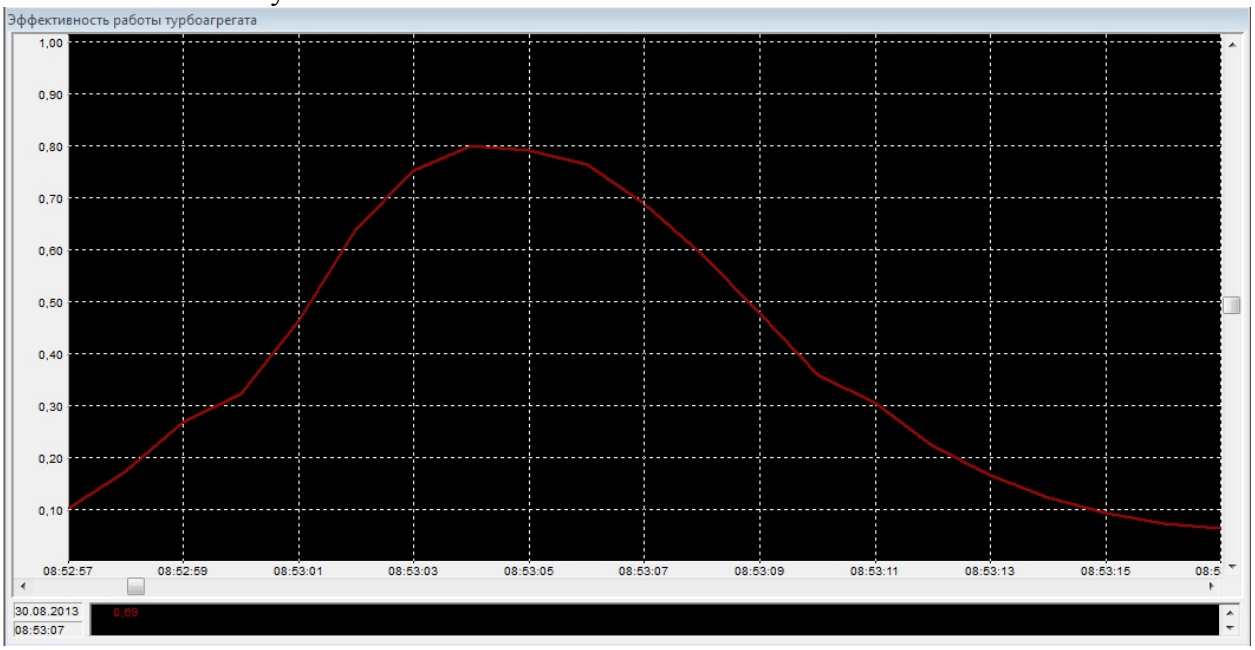

Figure 6 - Trace Mode window – $Ef_t(t)$.

Proposed hardware and software devices (see Fig. 3 and Fig. 5) allow to implement adaptive management efficiency of the power unit, consisting of a series connection of the boiler and turbine identification algorithm using the operating point unit (see Fig. 7).

Program algorithm consists of the following blocks: Block 1 of the reference model of the control object, block 2 implementing measure the current settings of the control object, block 3, which implements the calculation of the statistical characteristics of the measured values, block 4 to identify the magnitude and sign of the derivative block 5 for computing recommendations management.

The algorithm works as follows. Block 2 are measured (in terms of set of technical tools is responsible for this module AI - the analog input module) current values of X1(t) and $Ef_u(t)$ and accumulate arrays X1(iTS) and $Ef_u(t)$ of length N.

In block 3 assesses the statistical characteristics of these arrays on relations [3,7] (9 ÷ 13):

$$M_x = \frac{1}{N+1} \cdot \sum_{i=0}^{N} x_i \quad M_y = \frac{1}{N+1} \cdot \sum_{i=0}^{N} y_i \tag{9}$$

$$D[X] = M[|X - M[X]|^2] \tag{10}$$

Expressions 9 and 10 Mx, My - estimates of expectations values of input and output parameters; xi ≈ X1i, yi ≈ Efi - values of experimental data on entry and exit; N - length data sets. In the terms used centered 10 measured values

$$\Delta x_i = x_i - Mx \quad \Delta y_i = y_i - My \tag{11}$$

where Δxi, Δyi - centered values of input and output parameters;

There, in block 3, calculated estimates of the autocorrelation function (12) and the inter-correlation (13) functions:

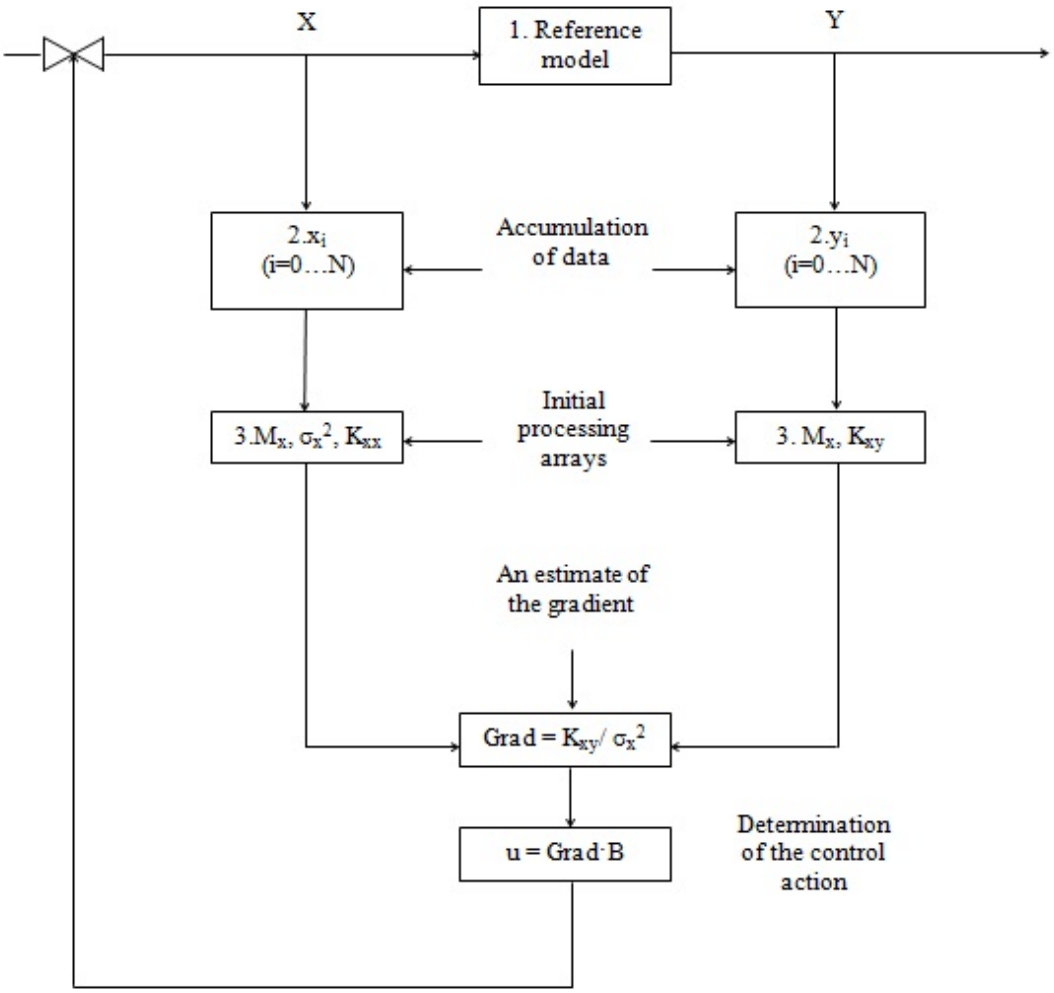

Figure 7 - Identification algorithm the operating point unit.

$$K_{X_1X_1}(j \cdot T_S) = \frac{1}{N-j} \cdot \sum_{i=0}^{N} X_1(i \cdot T_S) \cdot X_1(i \cdot T_S + j \cdot T_S) \tag{12}$$

$$K_{X_1Ef}(j \cdot T_S) = \frac{1}{N-j} \cdot \sum_{i=0}^{N} X_1(i \cdot T_S) \cdot Э_u(i \cdot T_S + j \cdot T_S) \tag{13}$$

In block 4 is made to estimate the gradient direction change $X_1(t)$:

$$GradX_1(j \cdot T_S) \approx \frac{K_{XEf}(0)}{K_{X_1X_1}(0)} \quad , \tag{14}$$

Block 5 is designed to produce recommendations for changing the variable X1(jTs) towards achieving the maximum efficiency of the power unit:

$$X_1(j \cdot T_S) := X((j-1) + K_{H1} \cdot \frac{K_{XEf}(0)}{K_{X_1X_1}(0)} \quad , \tag{15}$$

where KH1 - tuning ratio control algorithm, the value of which is usually chosen in the range:

$$K_{H1} \cong \pm 3 \cdot \sqrt{\sum_{i=0}^{N} (X_1(iT_S) - M_{X_1})^2} \qquad (16)$$

Since the control parameters are statistically independent variables, the movement towards achieving maximum power efficiency for variable X2(t) follows the same algorithm. Verifying algorithm carried out by simulation. Geometrical interpretation of the process of finding the maximum is shown in Figure 8.

Thus, experimental studies have revealed that the static characteristics of the boiler unit and a steam turbine unit are non-linear with a pronounced maximum [9,10] (see Figure 1 and Equation 1 ÷ 3). This allows you to select criteria as management of energy efficiency of the boiler unit (4) and the efficiency of the steam turbine (8). This allowed the design of software and hardware devices to measure the effectiveness of the boiler, as shown in Figure 3 and the steam turbine, see Figure 5. These hardware and software devices allowed to implement adaptive management of energy by the maximum efficiency of the power unit (3), that is, to realize the maximum efficiency of the search unit by an algorithm identifying the current position of the operating point of the power unit (14). Convergence and stability of the control algorithm was verified by simulation, see Figure 6. Metrological characteristics were tested according to the procedures described in [2].

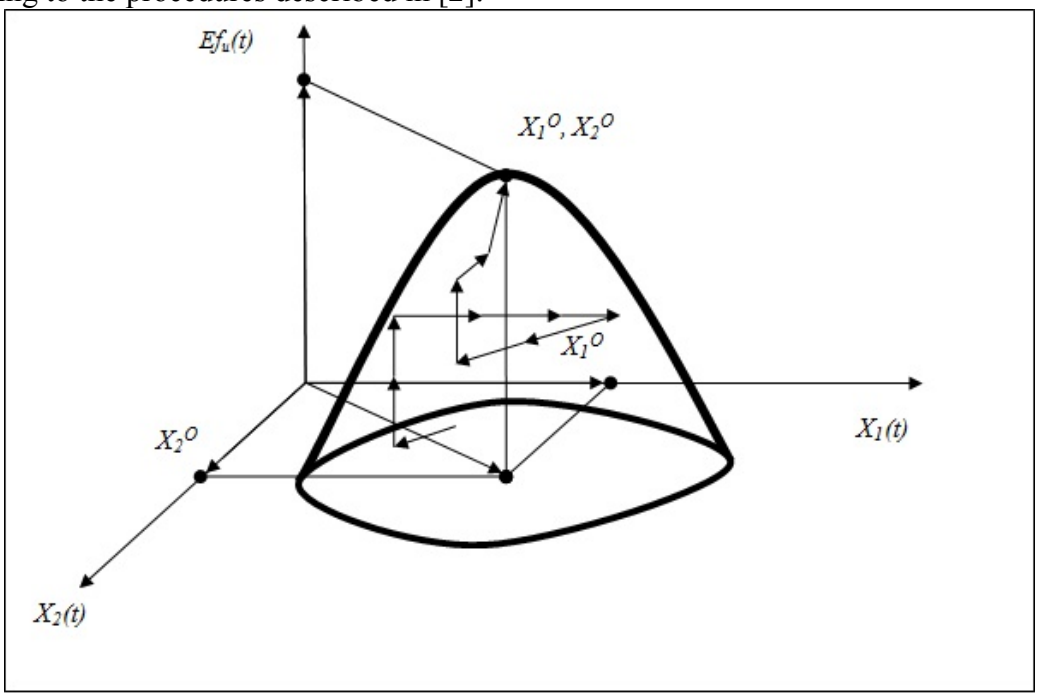

Figure 8 - Geometrical interpretation of the control algorithm.

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THE MAIN TASKS OF THE MODERN QUALITY MANAGEMENT AND INFORMATION SUPPORT TECHNOLOGY OF LIFE-CYCLE FOR HIGH TECHNOLOGY PRODUCTS

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The product life-cycle as an object of information support and the main tasks of the quality management requiring information support are considered. The use of CALS-technologies in the field of quality management systems at all stages of the product life-cycle contributes to the continuous improvement of product quality.

Keywords: product life-cycle stages, quality management, quality, information support, integrated information environment, CALS-technologies.

Analysis of the application of information technology in knowledge-intensive industries (defense industry, electronic industry) shows that one of their development direction is more complete coverage of the product life-cycle stages. The need to form an integrated information system that supports the entire product life-cycle has been fully appreciated only by the end of 90-ies of the XX century.

The product life-cycle is a set of processes performed from the detection of the society needs in a particular product to its disposal. A simple model of the product life-cycle contains the following stages:

- Marketing,
- Design and Development (engineering process);
- Production (including purchasing and testing);
- Product delivery (packaging, storage, delivery and installation);
- Exploitation (maintenance, repair and utilization).

The concept of Product Lifecycle Management (PLM) has appeared relatively recently. Committee called AC 327 Life Cycle Management Group was established in 2003 in the framework of NATO. In documents which are under preparation of this committee framework, given the following definition: Product Lifecycle Management is planning and execution of a complex coordinated organizational and technical measures, which are implemented throughout the life-cycle, that measures are used management, engineering and information technologies and they are designed to optimize the product properties according to the criteria of efficiency, cost and quality.

PLM is aimed at ensuring that all business processes and procedures of product life-cycle stages were mutually agreed to implement effective use and coordination of resources, information and technologies that are used in the product life-cycle.

The standard GOST ISO 9001-2011 «Quality Management Systems. Requirements» defines a set of requirements which should be satisfied from Quality Management System

(QMS) of the enterprise [1]. It is worth mentioning that each enterprise determines the goals and objectives in the field of quality management on its own account.

Chapter 7 «Product realization» of GOST ISO 9001-2011 describes the product life-cycle more fully. In the table you can see the main tasks of the quality management for each stage of the product life-cycle; these tasks are based on the standard requirements.

Table. The main tasks of the quality management and product life-cycle stages

Product life-cycle stages	**Tasks of the quality management (according to GOST ISO 9001-2011)**	**Remarks**
Marketing	Determination of requirements related to the product (7.2.1).	Records of all review results shall be maintained.
	Review of requirements related to the product (7.2.2).	
Design and development	Design and development planning (7.3.1).	-
	Determination of design and development inputs (7.3.2).	Requirements shall be complete, unambiguous and not in conflict with each other.
	Determination of design and development outputs (7.3.3).	Information can include details for the preservation of the product.
	Design and development review (7.3.4).	-
	Design and development verification (7.3.5).	Verification shall be performed in accordance with planned arrangements (see 7.3.1).
	Design and development validation (7.3.6).	Validation shall be completed prior to the delivery or implementation of the product.
	Control of design and development changes. (7.3.7).	-
	Provision of resources (6.1)	-
	Infrastructure (6.3)	Equipment maintenance for manufacturing processes (hardware, software means).
	Purchasing process (7.4.1)	-
	Purchasing information (7.4.2)	The organization shall ensure the adequacy of specified purchase requirements prior to their communication to the supplier.

Production	Verification of purchased product (7.4.3)	The organization shall establish the inspection of the purchased product.
	Control of production and service provision (7.5.1).	-
	Validation of processes for production and service provision (7.5.2).	-
	Product identification and traceability (7.5.3).	Product identification on all product lifecycle stages.
	Customer property management (7.5.4).	Customer property can include intellectual property or personal data.
	Control of monitoring and measuring equipment (7.6).	Calibration and verification records of results shall be maintained.
Product delivery	Preservation of product (7.5.5)	Preservation shall include identification, handling, packing, storage and protection
Exploitation	Customer communication (7.2.3)	-
	Data collection and analysis (8.4)	-

As the Table shows, two stages of the product life-cycle («Product delivery» and «Exploitation») are not sufficiently covered by GOST ISO 9001-2011 requirements; this can be explained because the following standard refers to the processes of the enterprise, rather than the processes of the product life-cycle.

Diversity of product life-cycle processes and the need for their intensification require active information exchange between organizations that are involved in their implementation and support.

CALS-technology (abbreviation CALS means Continuous Acquisition and Life Cycle Support) is modern approach to the design and manufacture of high-technology and knowledge-intensive products; it is used computer technology, modern information and automated tools at all stages of the product life cycle.

Russian equivalent of CALS is Information Product Life Cycle Support (rus. ИПИ). The main purpose of CALS-technologies introduction is minimizing costs during the product life-cycle, improving its quality and competitiveness [2, 3].

Applying CALS-technologies at enterprises which producing high-technology products, you are able to:

- expand the cooperation areas of various organizations;
- ensure continuity of work results in complex projects;
- reduce costs in business processes due to better balance of their units;
-ensure the required quality by electronic documentation of all processes and procedures;
- reduce production costs and as a result you can shorten a product cost;
- reduce the manufacture time of the product and increase its resource.

The need to build an integrated system for product life-cycle support leads to the

necessity of creating Integrated Information Environment for collecting and analyzing information about product quality at all stages of its life-cycle.

In this way, information support and maintenance of the product life-cycle are carried out in Integrated Information Environment. Dictionary of technical terms defines Integrated Information Environment as follows: «a set of distributed databases that contain information on products, production environment, resources, and processes of the company, databases ensure the correctness, relevance, integrity and availability of data subjects of industrial and economic activity. All information (data) is stored as information objects in Integrated Information Environment» [4].

A data set is created at each stage and this set will be used at later stages. The main volume of information compiles data about the product in Integrated Information Environment. At different stages of the product life-cycle require a different subset of the entire set of product data, characterized by their composition and information volume.

Information support of the product life-cycle is characterized by the following features:

-solvable problems are way beyond the individual enterprise; information exchange participants can be geographically separated from each other (for example, they can be in different cities);

-shared information is very dissimilar: these is marketing data, design and engineering data, manufacturing data, variety of data for product using, commercial and legal information and so on. Technology methods for presentation and the correct interpretation of data should be standardized for sharing.

There are the following basic principles of CALS-technologies in Integrated Information Environment:

-application software is separated from the data;

-data structures and access interface are standardized;

-product data, processes and resources data are not duplicated; the completeness and integrity of information are ensured.

Application of Integrated Information Environment provides information support and processes integration and accordingly personnel (in accordance with the access rights) have an opportunity to use electronic data, which were formed during the various enterprises processes, for quality control tasks.

The main objectives of CALS-technologies for implementation QMS tasks include the following targets:

1. Description technology business processes at different stages of the products life-cycle. Processes description as the information objects.

2. Technology of cut-through processing for application data in information system. Formats descriptions and presentation standards of an electronic product description, software and hardware and equipment descriptions, preparation, processing and transmission of data must be accompanied.

3. Production technology of electronic product description. Implementation of virtual products and processes description.

4. Technology of CALS-project management. This technology provides project participants with integrated environment access to timely and calendar plans, management plans with business processes, management objects, and performers and resources and also integrated environment track the status of projects, plans and works.

CALS-technologies implementation allows enterprises to create electronic description of QMS, and as a result - the acceleration of gathering information process for analysis and decision making for modifying the process. The application of these technologies in the QMS ensures that all factors (technical, human), affecting the quality of products, are under control.

All components of CALS-technologies are based on the principles of Total Quality Management (TQM). Formulated differently, principles of TQM have already been incorporated in the ideology of CALS-technologies. Accordingly, implementation of integrated information technology means automatic implementation of the total quality management principles for products at enterprises.

In this way, application of CALS technologies in the field of QMS at all product life-cycle stages contributes to the continuous improvement of product quality and allows the management company to ensure that all technical, administrative and human factors that have an impact on the products quality are under control and also management of the QMS considers the needs and expectations of the consumer and provides enterprise competitiveness.

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ABOUT THE EFFECTIVENESS OF "GRADUAL TRUNCATION" OF THE WALD SEQUENTIAL TEST

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The purpose of the paper is to research and compare the effectiveness of sequential probability ratio test (Wald test) for rectangular and parabolic truncation of boundaries by mathematic modeling. The actual risks of the supplier and the consumer, and the average number of trials needed to make a decision on acceptance or rejection are estimated.

Keywords: Wald test, parabolic test, Monte-Carlo simulation

Wald test [1], proposed by the American statistician A. Wald in 1943, is used in many fields of science and technology in the verification of two simple hypotheses (the main $H_0 : q = q_0$ and competitive $H_1 : q = q_1$ $(q_1 > q_0)$). It often becomes necessary to interrupt the test, although technically it is impossible to make a decision. In this case the so-called "rectangular" truncation regulated by standard [2] or sequential test with parabolic boundaries is used[3]. In this paper the Monte-Carlo method is carried out to compare the efficiency of these methods of truncation.

In state standard - GOST R 27.403-2009 “Reliability in the engineering. Test plans for the control of the probability of failure-free work” Wald test with truncation boundaries is implemented as follows:

- the set values of the supplier and the consumer risks α and β are multiplied by the coefficient K is less than unity. In the range of values α, β = 0.05-0.2 recommended value K = 0.9;
- the borders of the sequential test plan are calculated by the formulas:

$$k = a \cdot n + k_0 \text{ – border inconsistencies (rejection),} \quad (1)$$

$$k = a(n - k_0) \text{ – border compliance (acceptance).} \quad (2)$$

Constants in the formulas are:

$$a = \frac{ln\left(\frac{P_\alpha}{P_\beta}\right)}{lnD + \ln\left(\frac{P_\alpha}{P_\beta}\right)};\ k_0 = \frac{ln\left(\frac{1-\beta}{\alpha}\right)}{lnD + ln\left(\frac{P_\alpha}{P_\beta}\right)};\ n_0 = \frac{ln\left(\frac{1-\alpha}{\beta}\right)}{ln\left(\frac{P_\alpha}{P_\beta}\right)} \quad (3)$$

- the boundaries of single stage test plan *N* and *c* are calculated by the formulas:

$$1 - \alpha = \sum_{i=0}^{c} C_N^i \cdot P_\alpha^N (1 - P_\alpha)^i \quad (4)$$

$$\beta = \sum_{i=0}^{c} C_N^i \cdot P_\beta^N (1 - P_\beta)^i \quad (5)$$

- the borders *N* and *c* are increased on 5% - 7% and rounded up;
- the products are tested in accordance with the test program and the total number of observations and total number of failures are sequentially counted up;
- the trials are continued until the line of the realization of the process will intersect the first bounce of acceptance or rejection of the test plan, and depending on this the decision on acceptance or rejection is taken.

The test with parabolic boundaries is implemented as follows:
- the parabolic boundary criterion is calculated by the formulas:

$$k_0' = k_0 + (n - n_{min}^0)^2 \cdot b \quad (6)$$

$$k_1' = k_1 + (n - n_{min}^1)^2 \cdot c\ , \quad (7)$$

where k_0 and k_1 – borders, of the Wald test, defined by formulas (1-2);
b, *c* - correction coefficients, selected by modeling;
n – the number of independent trials;
n_{min}^0- the minimum number of trials to accept the main hypothesis (H_0), is calculated from the condition $k_0 = 0$ in equation (2):

$$n_{min}^0 = -\frac{\ln(A_0)}{\ln\left(\frac{1-q_0}{1-q_1}\right)} \quad (8)$$

n_{min}^1 - the minimum number of tests to accept the main hypothesis, is calculated from the condition $k_1 = n$:

$$n_{min}^1 = \frac{\ln(A_1)}{\ln\left(\frac{q_1}{q_0}\right)}. \quad (9)$$

If $k \le k'_0$, the main hypothesis H_0 is accepted, and if $k \ge k'_1$ - competing H_1.

For realization of the algorithm of modeling the random numbers, having binomial distribution, that describes the number *m* of occurrences in the series of *n* trials, in which an event occurs with probability *p*, are generated. Program of the counting the number of events in the series is realized as follows [4]:

$$m = \sum_i J(p)\ , \quad (10)$$

where *J(p)* - the event indicator is 1 when the event occurred, and is 0 otherwise.

Some modeling results of the Wald test with truncation boundaries and test with parabolic boundaries are shown in Table 1.

Table 1. The modeling results of the criteria

Binomial distribution														
given risks		actual risks		Type test	Average sample size, items									
					$q=q_0$			$q=(q_0+q_1)/2$			$q=q_1$			
□	□	□□	□□		accept	reject	common	accept	reject	common	accept	reject	common	
$q_0 = 0{,}1$		$q_1 = 0{,}2$												

0.1	0.1	0,1276	0,0938	rectangular truncation	47,9	61,1	49,6	56,4	55,5	55,9	53,2	41,4	42,5
0.1	0.1	0.9910	0.9885	parabolic truncation	43,8	48,3	44,4	48,9	45,0	46,7	46,5	34,6	36,0
0.3	0.3	0,1883	0,3401	rectangular truncation	13,9	9,1	13,0	14,8	9,4	12,6	15,3	9,2	11,5
0.3	0.3	0.2981	0.2977	parabolic truncation	12,2	10,1	11,7	12,7	10,1	11,5	12,6	9,24	10,3
0.05	0.3	0,0491	0,3014	rectangular truncation	28,2	41,9	28,8	37,1	42,5	38,7	38,0	37,1	37,4
0.05	0.3	0,0625	0,347	parabolic truncation	21,5	35,6	22,4	25,3	33,4	27,9	26,6	28,8	28,0
0.3	0.05	0,2803	0,0520	rectangular truncation	47,8	34,2	44,0	53,2	31,7	37,8	54,6	24,4	26,0
0.3	0.05	0,3025	0,0512	parabollic truncation	40,1	25,9	35,40	43,7	24,0	29,0	45,6	18,7	20,4
0.05	0.05	0,0515	0,0584	rectangular truncation	73,6	87,7	74,4	99,3	88,8	93,4	90,6	61,6	63,3
0.05	0.05	0,0512	0,0520	parabolic truncation	66,1	87,7	68,0	82,8	79,2	80,5	63,2	54,1	54,5

Based on the modeling results, the following conclusions can be made:

- the most effective test is the test with parabolic boundaries (requires on average 10-20% less than the Wald test with rectangular truncation);
- Wald test with rectangular truncation is applicable for relatively high risk ($\alpha, \beta \geq 0.1$) and not close hypotheses ($q_1/q_0>1.5$);
- when approaching estimated competing hypotheses Wald test with truncation becomes inapplicable due to higher actual risks.

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BOOTSTRAP AND ITS PLACE IN PRODUCT QUALITY MANAGEMENT

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Bootstrap methods and trend of their development are considered. An opportunity of the bootstrap technology application for statistical process control based on control charts is shown. The comparative analysis of reliability using classical method, "jackknife" method and bootstrap was carried out.

Keywords: bootstrap, statistical process control, control charts, reliability.

Computer technologies are gaining more popularity, giving rise to the development of statistical methods. Automated methods of quality and reliability analysis are getting the increased use. Bootstrap is among them. It was proposed by B. Efron in 1979. [1] The simplicity and accessibility of bootstrap contributed to its application in various fields of scientific knowledge - from ecology, sociology and economics to nuclear energy, engineering sciences and information technologies. In the area of quality management should notice the use of this method for control charts construction and reliability analysis implementation.

One of the first algorithms was proposed by M. Quenouille in 1949. It requires consistent, repeated exclusion from an available sample of N elements one of its members and processing the ordered sample of the remaining (N - 1) elements. Mean, variance or median will thus "walk" so that it is possible to analyze the information about bias, construct distribution of the sample estimate for the required parameter and specify its properties. [2] J. Tukey [3] in 1958 expanded on the technique and proposed the name "jackknife" since, like a boy scout's jackknife, it is a "rough and ready" tool that can solve a variety of problems even though specific problems may be more efficiently solved with a purpose designed tool.

Bootstrap was proposed [1] as a generalization of the "jackknife" algorithm without reducing the number of elements compared to the original sample.

It is impossible to obtain complete information about the studied object variability, if there is only one sample of N volume. Bootstrap allows simulating the required number of samples from the original data and carrying out statistical analysis on the received subsamples. It is assumed that the available N values form general population. The subsamples are extracted with the return of N size and equal probabilities (1/N) of each value extract. Totally, the B subsamples are extracted and for each of them the studied parameter evaluation of an original random value is constructed, then the estimates are to be averaged. [4]

It is possible to generate any arbitrarily large number of bootstrap subsamples and obtain information about the examined values distribution. Bootstrap is a more economically viable way of statistical research that uses all the computer computational abilities, but eliminates the need for additional in-situ measurements. Yu. Adler et al. examined the use of traditional methods for solving problems of reliability theory [4-7].

The lack of knowledge about the estimated parameter distribution leads to difficulties in control charts constructing, especially in control limits determining. Bootstrap is a non-parametric technique that does not rely on the assumption of a parametric distribution of the

observed characteristics. It is used for developing both univariate and multivariate control charts for processes monitoring.

In [8-13] the possibilities of bootstrap application for the control charts construction are studied. Liu and Tang proposed bootstrap-based control charts that can monitor both independent and dependent observations. Jones and Woodall discussed the performance of techniques for constructing bootstrap control charts. Lio and Park proposed bootstrap control charts based on the Birnbaum – Saunders distribution. Later Park proposed median control charts, in which control limits were determined by estimating the variance of the sample median via the bootstrap technique.

P. Erto et al. proposed innovative control charts of Weibull percentiles using Bayesian estimators supported by bootstrap methods. The estimation procedure is able to effectively integrate both experimental and technological information using Bayesian estimators and bootstrap allows capitalizing the experimental information provided by few samples. In reliability problems, the control charts of Weibull percentile are strategic.

Obviously, for highly reliable products collecting enough data is a complex task, so the use of classical control charts is problematic. In these cases the proposed Bayesian approach may become an appropriate one.

The Weibull survival function is:

$$\mathrm{Sf}\{x;\delta,\beta\}=\exp\left[-(x/\delta)^{\beta}\right];\qquad x\geq 0;\qquad \delta,\beta>0 \tag{1}$$

that can be expressed in terms of the percentile and shape parameter β:

$$\mathrm{Sf}\{x;x_R,\beta\}=\exp\left[-K(x/x_R)^{\beta}\right];\qquad x\geq 0;\qquad x_R,\beta>0$$
$$K=\ln(1/R) \tag{2}$$

x_R and β are both unknown.

The algorithm for constructing the control charts of Weibull percentiles via Bayesian - bootstrap approach has the following steps:

- ***The training resampling procedure***

1) Collecting samples with sample size *n* from an in-control process. The samples are assumed to come from the Weibull distribution with unknown parameters x_R and β.

2) Combining all the observations into a single "combined sample". Bootstrap allows to use it as a surrogate for the Weibull population.

3) Resampling from the "combined sample" *M* "resamples" of *n* size. It is generally sufficient M=1000.

4) Obtaining the estimates x_{Rj} and β_j of x_R and β for each resample (j=1,…,M).

5) Calculating the averaged robust estimates over the all *M* "resamples".

- ***The empirical sampling distribution***

1) Replacing the unknown Weibull parameters with the estimates obtained in 1.5

2) Generating sufficiently large time *B* (i.e., 10000) "parametric bootstrap samples" x^* of *n* size from the estimated Weibull distribution and obtaining *B* estimates x^*_{Ri} (i=1,…,B).

3) The frequency distribution of these estimates represents an empirical sampling distribution of the Weibull percentile estimator

- ***The estimation of statistical control limits***

1) Defining the Lower Control Limit (LCL).

2) Defining the Upper Control Limit (UCL).

3) Defining the Center Line (CL).

During the reliability tests outliers are not excluded, they may be caused by observation results errors or errors due to the equipment imperfection and data heterogeneity.

As the requirements to the accuracy of electronics products technical condition estimation increases, methods based on simplified forecasting of the equipment degradation processes become ineffective.

The forecasting of the electronics products technical condition using tests data based on traditional methods without preliminary data processing significantly hampered. For example, while estimating parameters of electronics products and forecasting their resource upon the tests results in small-scale production should be considered the following:

- The number of samples to be tested is very small.
- Parameters, that characterize the electronics products technical condition, change slightly in the course of the tests.
- Availability of data outliers.

In such conditions the devices recourse forecasting without information about the distribution law of parameters and data preprocessing (e.g. excluding outliers) is a comprehensive task. In case, when there is no ability to obtain true repeated observations the methods of jackknife and bootstrap are used.

For example, assume that mean time between failures (MTBF) of electronics products were respectively 85, 105, 115, 110, 125, 125 and 130 thousand hours.

It is necessary to estimate sample median that can give the most faithful representation of a true value of the MTBF parameter.

The ordered sample is made of the original data:

X=85, 105, 110, 115, 125, 125, 130

Sample median is calculated on the basis of the original data:

Med(X)=x in the case of even n (where n - sample size)

Med(X) = in the case of odd n

Med(X)= 115

Use the jackknife method and receive the subsamples as follows:

X^*_1=105, 110, 115, 125, 125, 130;

X^*_2=85, 110, 115, 125, 125, 130;

X^*_3=85, 105, 115, 125, 125, 130;

X^*_4=85, 105, 110, 125, 125, 130;

X^*_5=85, 105, 110, 115, 125, 130;

X^*_6=85, 105, 110, 115, 125, 130;

X^*_7=85, 105, 110, 115, 125, 125;

Sample median, respectively:

Med(X1)= 120

Med(X2)= 120

Med(X3)= 120

Med(X4)= 117,5

Med(X5)= 112,5

Med(X6)= 112,5

Med(X7)= 112,5

The resulting values are averaged:

$Med_{jack}(X)$=116,43

The jackknife estimate is the less accurate but it gives the less bias compared to the classical methods (Fig. 1):

σ=15,47

σ_{jack}=3,78

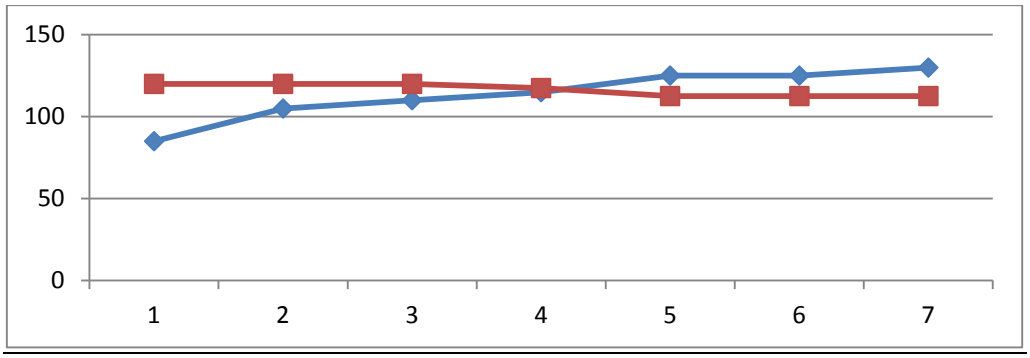

Fig. 1. Graph of the median values distribution by the classical method and the jackknife method.

It is proposed to form a lot of bootstrap subsamles Y_1 ,Y_1 , … , Y_n and use the values distribution $f(Y_1)$, $f(Y_2)$, … , $f(Y_n)$ as an estimate to calculate the exploring statistic value using bootstrap. The Y_i sample is formed as follows: the random number k(j) defindes for each j = 1, 2, … , n by the statistical tests. The k(j) are equally distributed on the set {1, 2, ..., n}, and assume:

$$Y_i = (x_{k(1)} , x_{k(2)} , \dots , x_{k(n)})$$

Supposed that the rooms k (1), k (2), ..., k (n) are selected independently of each other.

For the example above it is assumed that uptime of the technical system obeys the Weibull distribution with the parameters S = 0,5; 1; 2. For the probability of faultless operation modeling the generator of pseudorandom numbers in the interval (0, 1) was used. The number of experiments is 100. The number of MTBF parameter observations - 5, 10, 100. The software used: Excel, Mat Lab.

After comparing the estimates of the average failure rate for the technical system by the classical method, bootstrap and jackknife, the following results were obtained (Table 1).

Table 1. Comparative table of the reliability analysis results

S	λ	λ_{jack}	λ_{boot}	σ	σ_{jack}	σ_{boot}
N=5						
0,5	0,0022131	0,0022131	0,0021583	0,0027803	0,0000279	0,0002753
1	0,0011827	0,0011827	0,0011822	0,0006027	0,0000061	0,0000659
2	0,0010295	0,0010295	0,0010274	0,0002555	0,0000026	0,0000269
N=10						
0,5	0,0015549	0,0015549	0,0015460	0,0009692	0,0000098	0,0000254
1	0,0010954	0,0010954	0,0010969	0,0003439	0,0000035	0,0000375
2	0,0010127	0,0010127	0,0010109	0,0001650	0,0000017	0,0000184
N=100						
0,5	0,0010424	0,0010424	0,0010438	0,0002440	0,0000025	0,0000254
1	0,0010132	0,0010132	0,0010136	0,0001086	0,0000011	0,0000116
2	0,0010052	0,0010052	0,0010061	0,0000544	0,0000005	0,0000057

Thus, jackknife and bootstrap estimates are hardly differ from the classical evaluation. Nevertheless, the bootstrap standard deviation is an order less than the classical method, and the jackknife standard deviation is two orders less than the classical one, thereby increasing the estimation accuracy.

In summary it can be noted that the use of bootstrap for statistical process control becomes relevant because of the possibility of application in cases when the distribution of the

observed value is unknown, as well as the ease of calculations performed on a personal computer. Bootstrap approach is quite convenient to perform calculations based on resampling and statistical estimation. It is particularly effective when there is a limited number of data to make forecasts about the processes or systems behavior.

The matters of the bootstrap application for the reliability analysis, electronics products particularly, are still relevant, as evidenced by the continued emergence of new papers on the subject.

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QUASI-HETERODYNE METHOD OF THE PHASE MEASURING IN A SERIES OF INTERFEROGRAMS

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This paper proposes a method for measuring the phase difference based on the analysis of Lissajous figures formed intensities of pairs of points in a series of interferograms with different phase shifts. This method does not require the definition of the actual values of the phase shifts.

Keywords: interferogram, phase shift, Lissajous figures, interferometry

1. THE PROBLEM

The aim of this work is an explicit determination of the phase difference on the intensity values of two arbitrary points in the interferogram using the method of step phase shift [1-5]. Moreover, in the present time a lot of attention paid to the analysis of the measurement errors caused by inaccuracy of the phase shifts [6-11]. Equation intensities at each point of the interferogram at different values of insertion phase shift can be written as [3]:

$$\mathrm{I}_i(\mathrm{x},\mathrm{y}) = A(\mathrm{x},\mathrm{y}) + B(\mathrm{x},\mathrm{y})\cos\left[\phi(\mathrm{x},\mathrm{y}) + \delta_i\right], \quad (1)$$

where $A(\mathrm{x},\mathrm{y})$ - average brightness, $B(\mathrm{x},\mathrm{y})$ - the amplitude of the interference fringes.

May be assumed that all points (x, y) phase shifts are the same. This assumption is satisfied in most cases on the basis of physical conditions of the experiment. Then we can get the additional equation, considering the decisions are not in one but in several spatial points interferogram.

$$\mathrm{I}_i(\mathrm{x}_k,\mathrm{y}_k) = A(\mathrm{x}_k,\mathrm{y}_k) + B(\mathrm{x}_k,\mathrm{y}_k)\cos\left[\phi(\mathrm{x}_k,\mathrm{y}_k) + \delta_i\right]. \quad (2)$$

2. DESCRIPTION OF THE METHOD

If you take two arbitrary points on the interferogram with coordinates $A(x_A,y_A)$ and $B(x_B,y_B)$, then the five phase shifts we obtain a system of ten equations of the form (2) with ten unknowns.

To simplify notation the intensity change in the system of equations (2) I_{1A} … I_{5A} as x_1… x_5, intensity and I_{1B} … I_{5B} as y_1… y_5 and the average brightness levels at the points and - x_0 and y_0, respectively. Taking into account the adopted notation system of equations (2) takes the form

$$x_i = x_0 + B_1\cos\left(\phi_1 + \delta_i\right), \quad y_i = y_0 + B_2\cos\left(\phi_2 + \delta_i\right), \quad (3)$$

here i=0,1 ... 4, $\delta_0 = 0$.

The system of equations (3) (x, y) can be regarded as the coordinates of points on a plane (fig. 1). Point 1 corresponds to a phase shift $\delta_0 = 0$. If the condition $\delta_0 < \delta_1 < \delta_2 \ldots < \delta_4$ is at this point 1 to point 2 switches , etc. This condition is required for the formation of a consistent trajectory of the point 1. For arbitrary phase shifts the trajectory of the point 1 would be move a chaotically. In this case, to ensure a consistent trajectory points can be sorted using the conditional vector formed by the difference between the coordinates of points and the coordinates of the center of the conditioned which is found by averaging the coordinates of all the points. Conditional vectors are compared with each other values of the angles which they form between themselves.

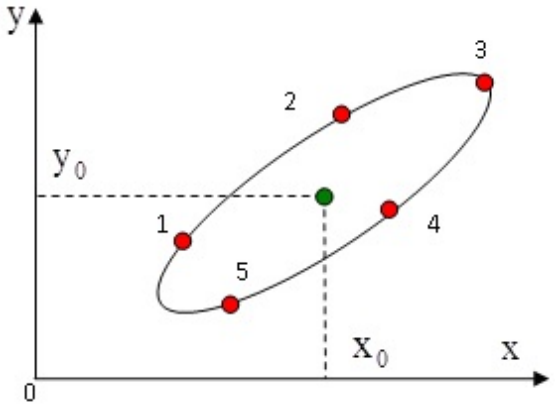

Figure 1. Coordinates of points on a plane

Any point corresponding to the system of equations (3) belongs to a well-known ellipse as Lissajous figure (addition of two sinusoidal waves of the same frequency). Then the system of equations (3) can be rewritten as follows:

$$x_i = x_0 + B_1 \cos(\delta_i), \quad y_i = y_0 + B_2 \cos(\delta_i + \phi_2 - \phi_1), \tag{4}$$

here $\phi_2 - \phi_1$ - the phase difference between two different points in the interferogram

Lissajous ellipse equation corresponding to the system of equations (4) has the form

$$\frac{(x_i - x_0)^2}{B_1^2} + \frac{(y_i - y_0)^2}{B_2^2} - 2\frac{(x_i - x_0)(y_i - y_0)}{B_1 B_2}\cos(\phi_2 - \phi_1) = \sin^2(\phi_2 - \phi_1) \tag{5}$$

However, the direct determination of the coefficients of equation (5) encounters great difficulties because, as a rule, it is necessary to find the unknown parameters of average brightness and amplitudes or their evaluation [12]. On the other side of the general equation of an ellipse can be represented as follows [13]:

$$a_{11}x^2 + 2a_{12}xy + a_{22}y^2 + 2a_{13}x + 2a_{23}y + a_{33} = 0. \tag{6}$$

Given the invariance of the leading coefficients of the equation (6) to the plane of the ellipse parallel transport module can be the cosine of the phase difference $\phi_2 - \phi_1$ of the coefficients of the following equation (6) $a_{11} = \frac{1}{B_1^2}$, $|a_{12}| = \left|\frac{1}{B_1 B_2}\cos(\phi_2 - \phi_1)\right|$ and $a_{22} = \frac{1}{B_2^2}$.

We compute the coefficients listed equation (6) using the equation of the pencil of curves of the second order [14]:

$$f_1(x,y)\cdot f_2(x,y) = \alpha f_3(x,y)\cdot f_4(x,y), \tag{7}$$

here $f_i(x,y) = A_i x + B_i y + C_i$ - is the equation of a straight line, and α is selected so that the curve is selectable from a beam passing through a free point 3 (see Figure 2).

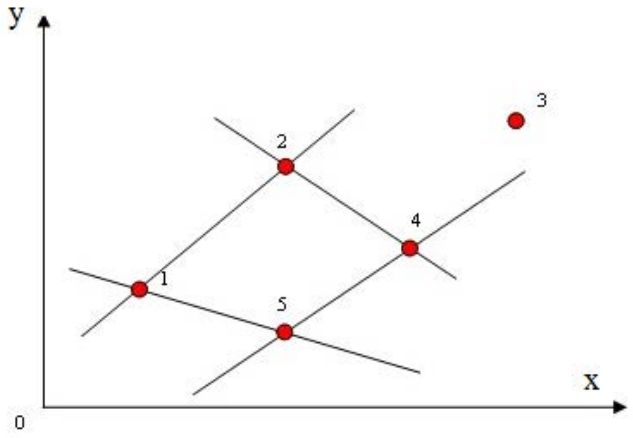

Figure 2. The procedure for connecting the points forming the beam curves

Then

$$A_1 = y_2 - y_1, \quad B_1 = x_1 - x_2, \quad C_1 = x_2 y_1 - x_1 y_2,$$

$$A_2 = y_5 - y_4, \quad B_2 = x_4 - x_5, \quad C_2 = x_5 y_4 - x_4 y_5,$$

$$A_3 = y_5 - y_1, \quad B_3 = x_1 - x_5, \quad C_3 = x_5 y_1 - x_1 y_5,$$

$$A_4 = y_4 - y_2, \quad B_4 = x_2 - x_4, \quad C_4 = x_4 y_2 - x_2 y_4,$$

$$\alpha = -\left(A_1 x_3 + B_1 y_3 + C_1\right)\left(A_2 x_3 + B_2 y_3 + C_2\right) \Big/ \left[\left(A_3 x_3 + B_3 y_3 + C_3\right)\left(A_4 x_3 + B_4 y_3 + C_4\right)\right]$$

and we obtain

$$a_{11} = A_1 A_2 + \alpha A_3 A_4, \quad a_{12} = \frac{1}{2}\left[A_1 B_2 + A_2 B_1 + \alpha\left(A_3 B_4 + A_4 B_3\right)\right], \quad a_{22} = B_1 B_2 + \alpha B_3 B_4, \tag{8}$$

In our case the module is equal to the phase difference $\left|\phi_2 - \phi_1\right| = \left|\operatorname{acos}\left(\frac{|a_{12}|}{\sqrt{|a_{11}|}\sqrt{|a_{22}|}}\right)\right|$. is defined in the range from 0 to $\frac{\pi}{2}$, for determining the true value of the phase difference in the

range from 0 to 2π is also necessary to determine the quadrant in which the angle $\phi_2 - \phi_1$. Practically, this can be done by tracking the orientation of the main axis of the ellipse and the direction of change in the trajectory of point 1 at different phase shifts (Fig. 1).

3. CONCLUSION

This paper proposes a new method for determining the phase difference of two arbitrary points of the interferogram. Fixing one of the points can determine the distribution of the phase-field over the field. Using this method allows to reduce the requirements for setting accuracy insertion phase shifts can be used as measuring systems with a priori unknown insertion phase shifts.

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CLASSIFICATION OF INCIDENTS FOR MANAGEMENT OF INFORMATION SYSTEM

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The report reviews problems of developing the incident`s management system (IMS) prototype, based on the ontological approach and semiotic modeling. It supports decision – making by the experts who are responsible for operation and management of complex information systems. The semiotic model of subject field under consideration is presented in the form of a graph, graph vertices are interpreted as objects, and graph arcs are interpreted as relations between them. In the IMS prototype under development 6 types of objects are used: the information system of organization, its subsystems, hardware-software components, groups of objects, atomic objects and related incidents and 6 types of relations between them. The classification principles used in incident recording by IMS tools as information system components are proposed.

Keywords: information system, incident management, classification, ontology

1. INTRODUCTION

The basic drawback of many current incident management systems (IMS) is that the user, say, a specialist of technical support service, has no possibility to see the cause - and - effect relations between events recorded by information systems (IS) tools. Such events are called incidents, that is any events affecting adversely on the normal functioning of IS components and lead to its malfunction [1] are related to these incidents. Available tools do not allow to specify the causes, which could lead to this incident or the number of recorded incidents connected with a selected management object.

The developed IMS prototype based on the ontological approach principles and semiotic modeling and supporting the decision-making by experts responsible for IS operation and management is designed to solve the above tasks.

The entry point in the IMS prototype is organization name (arbitrary name specified by the developer or the user), the incident ontology was made for IS of this organization. Records on all objects fixed by the IMS prototype tools can be presented in XML format. To store the records on organizations, the following data structure is used:

```
<nodetype name="ENTERPRISE" >
    <property name="enterprisename" type="String" />
    <property name="comment" type="String" />
</nodetype>,
```

where element "*enterprisename*" is designed to store organization names, and element "*comment*" designed to store expanded description - help.

2. INCIDENT CLASSIFICATION

Two classifiers are used in the IMS prototype to sort out data on recorded incidents and provide the search among them.

The basis of the first classifier is the statement that any information system can be presents as an assembly of its subsystems. As an example of subsystem can be network, server equipment, user workstations, operating systems or virtual infrastructure. Each information system can include arbitrary number of subsystems; the same subsystem can be a part of the information system of single, several or all available organizations. The structure of data on records on subsystems is generally similar to the organization record.

Each subsystem contains the set of hardware-software components, which form this subsystem. Physical and virtual equipment as well as software are related to the components. The following data structure is used to store the component records:

```
<nodetype name="COMPONENT" >
   <property name="compname" type="String" />
   <property name="vendor" type="String" />
   <property name="comment" type="String" />
</nodetype>
```

Here "*compname*" is the name of equipment series and model or the software name and version, "*vendor* "is a manufacturer, "*comment"* is a detailed characteristic, IMS users unfamiliar with one or another component can fast specify its type and the belonging to a specific subsystem.

Each hardware-software component of IS subsystem contains groups of objects combined by specific attributes. For example, for OS Windows Server 2003 such groups are device drivers, file system, network and system services; for notebook Lenovo ThinkPad T60 such groups are storage battery, wireless module, hard disk and random access memory.

Groups form objects which are atomic from the standpoint of binding to incidents in the designed ontology (objects are similar to configuration items in databases CMDB, used by the process of configuration management in library ITIL [2]). The object can be incident cause, or the object can be affected by incidents due to others objects.

Each incident fixed by IMS prototype tools is related to one or several objects depending on the number of objects which can lead to the incident or can be affected by this incident. The incident is record on the event, which led to the degradation of IS operation parameters n. The incident structure is described as follows:

```
<nodetype name="INCIDENT" >
   <property name="code"   type="String"   />
   <property name="message"   type="String"   />
   <property name="severity"   type="String"   />
   <property name="type"   type="String"   />
   <property name="event"   type="String"   />
   <property name="action"   type="String"   />
   <property name="osi"   type="Float"   />
   <property name="comment"   type="String"   />
</nodetype>
```

In this structure element "*code"* is used to store the incident symbol identifier in workplace of user graphical interface of IMS prototype .

Element "*message"* contains the standard error message generated by hardware and software. If an error occurs the IMS user can search a required incident according to this message or its part.

Element "*message*" is single element in the incident description structure which contains the record in English. This allows to use IMS both during operation with software which did not undergo localisation, and with foreign reference systems.

Element "*severity"* defines the degree of severity of the incident impact on the organization`s IS. Based on this information IMS users take decision on maximum acceptable time of incident settlement and used resources – material, financial and human. It can have the following values:

- Low level of effect – the incident exerts an insignificant influence on the operation of any one user or object as part of IS hardware - software. The incident settlement is non-

priority and it does not require special skills. An example can be the storage battery replacement in notebook or the elimination of paper jam in printer tray.

- Average level of effect – the incident influences on the operation of several users or due to this incident any one user or object cannot perform most of functions. The incident should be settled during 24 hours after its detection in the absence of other incidents with more high priority. An example of that incident is the prolongation of user certificate (password) validity period for the access to corporative mail or introduction of changes in adjustments of NTP server designed for time synchronization at workstations of personnel.
- High level of effect – the incident exerts negative influence on the whole subsystem as part of information system or due to this incident many specialists cannot perform their tasks. The incident should be settled generally after its detection. An example is inoperability of internal DNS server of the organization or sudden work stoppage of mail server .
- Critical level of effect – the incident disturbs the normal operation of some IS subsystems, the personnel cannot normally work. To settle the incident, all available organization resources are used, if required, another specialists are engaged. Such incidents can be the following ones: damage of optical fiber integrity at the input in the data storage and processing center or hardware failure of one or group of servers supporting the normal operation of organization virtual infrastructure.

Using element "*type"* the IMS user can determine the IS subsystem as part of which is the object connected with this incident. For example, if incidents in mail system made on the basis of software IBM Lotus*, element "type"* can take values «Client Lotus Notes» or «Server Lotus Domino» depending on whether the incident influences on client or server software.

Element *"event"* is designed for the storage of detailed incident description. It contains the information adding and explaining the standard error message in the "*message*" field as well as describing the conditions that led to its emergence, basic attributes and possible influence on other objects.

Element *"action* " contains the instruction on incident settlement presenting recommended sequence of actions performed and recorded during the initial incident settlement. In addition to the element can contain references to another resources including required information, software corrections, actual driver versions and etc.

Element "*osi*" contains service information inaccessible for the user and designed for the classifier operation which is connected with use of open systems interconnection reference model, OSI in developed IMS prototype. The use of this classifier will be considered in detail later on.

Element "*comment* "contains the set of key concepts or phrases describing the incident as a whole. This element adds element "*code"*.

The following data structure is used to connect an atomic object a with an incident:

```
<edgetype name="OBJECT_INCIDENT" from="OBJECT" to="INCIDENT" >
    <property name="issuedby" type="Boolean" />
    <property name="affect" type="Boolean" />
    <property name="comment" type="String" />
</edgetype>
```

The value of properties *"issuedby"* and "*affect"* allows to specify, whether the incident was caused by object failure or itself led to its malfunction (affect).

Sources for incidents in IS can be not only objects but other incidents both inside considered IS subsystem and beyond this subsystem. For example, an error of network driver adapter can lead to the various incidents related to the availability of network resources and remote management possibilities.

Fig.1 presents an example of incident belonging classification according to the considered classifier based on sequential allocation of subsystems, components and atomic objects as parts of IS. In this example the incident with description «Replication error of catalog service changes Active Directory» is caused by current catalog service adjustments Active Directory (it is considered as an atomic object including in object group «Network services» of component Windows Server 2003 of subsystem «operating systems"; in its turn the incident cause is «Error of computer authentication in domain: the above confidencel record is no available in database». To ensure the uniqueness of each object record, decimal identifiers are used

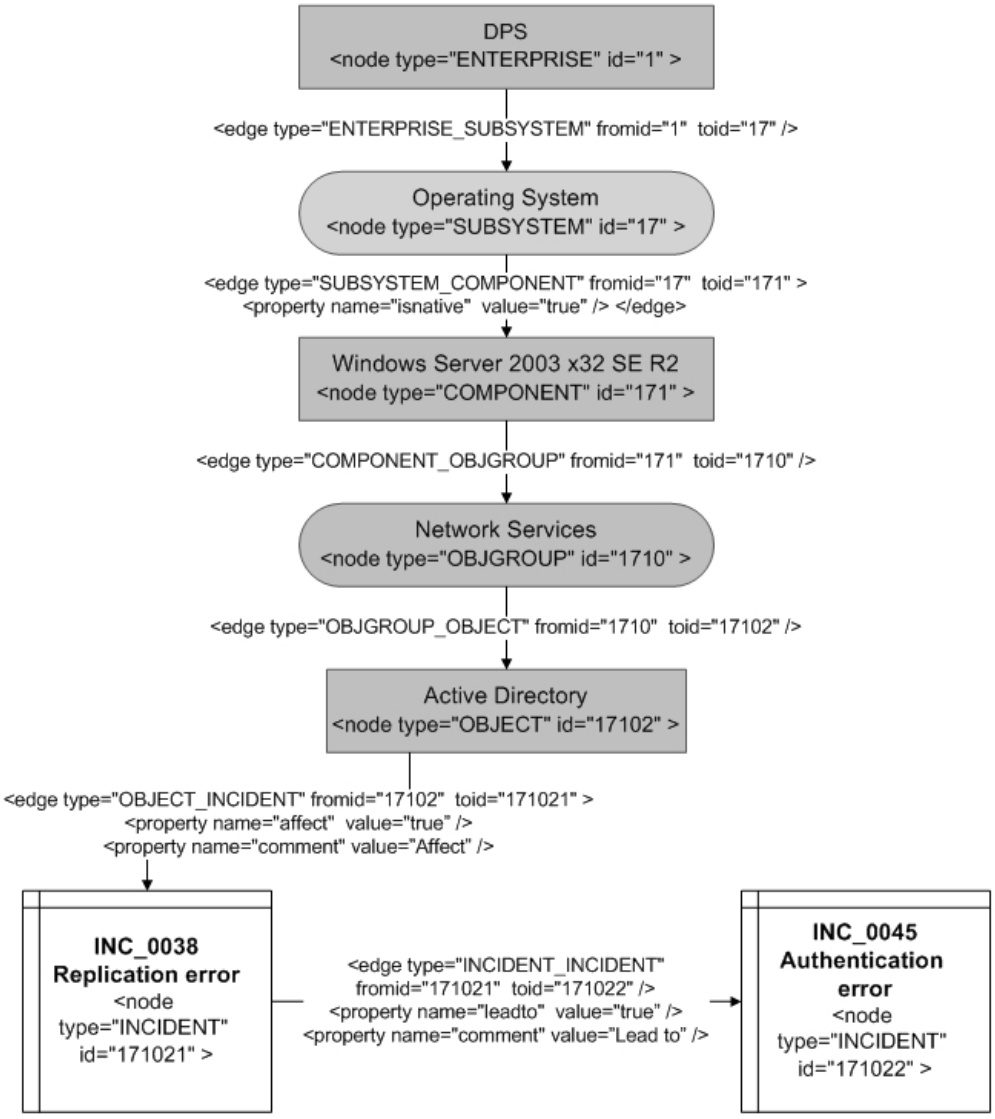

Fig..1 – Incident classification

3. HIERARCHY OF OBJECTS USED IN IMS PROTOTYPE

So, the semiotic model of considered subject field [3] is presented in the form of a graph, graph vertices are interpreted as objects and graph arcs are interpreted as relations between them. The developed IMS prototype uses six types of objects: information system of organization used IS, IS subsystems, hardware-software components of subsystems, groups of objects as part of components, atomic objects and related incidents and six types of relations (connections) between objects:IS – subsystem, subsystem – component- component – object group, object group – atomic object, atomic object – incident and incident – incident.

Six types of presentations are offered for IMS user. These presentations are different depending on the central object for this presentation. The presentation on default is the type containing organization name as well as all subsystems as part of its IS. When going to an arbitrary subsystem (selecting it as new central element), the user obtains access to description and composition of all hardware-software components. In order to make this presentation (select all objects as its part and connections between them), the following graph girth algorithm is used: for given vertex - IS subsystem - all related arcs are sequentially looked through, and for each arc all related vertices. If vertices and arcs meet the above conditions, they are selected for appropriate presentation.

In used tool Thinkmap SDK [4] this algorithm is recorded using so-called terminal conditions and can be presented as follows:

```
<sequence match="all" >
   <condition>is('SUBSYSTEM')</condition>
   <condition>is('SUBSYSTEM_COMPONENT')</condition>
   <condition>is('COMPONENT')</condition>

</sequence>
```

This syntax structure means that for the presentation with central element are selected only elements of relevant types connected with it directly by relations-arcs.

The presentation of next level contains the object of COMPONENT type as a central element. Notice that any hardware-software component can be a part of only single subsystem but at that it can be connected with arbitrary number of other subsystems. For example, client IBM Lotus Notes is related to mail system, however, its operation can be affected by incidents in other subsystems: operating system failure, physical failure of computer network adapter. In order to the IMS prototype user had possibility to control the mutual influence of components of different subsystems which are not connected directly, for this presentation are selected not only «parent » subsystem but all subsystems which can influence on this component, what means the use additional conditions in graph girth algorithm. Moreover the presentation of this level contains the object groups selected in the component, the user can more exact classify the incidents .

The presentation of lowermost sixth level contains as central element directly incident and it is more informative. When objects are selected for this presentation, the following conditions are considered:

- The incident can be caused both by arbitrary atomic object as part of IS and an other incident.
- The incident can lead to malfunction of individual objects as part of IS and hence, it is basic cause of other incidents.
- Single incident can influence on many atomic objects as part of various IS subsystems; the failure of various objects as part of IS can lead to the same incident.

According to these statements the following is selected for the presentation: all atomic objects connected with considered incident, all incidents led to this incient or caused in turn by it as well as all atomic objects connected with it (Fig. 2).

Incidents recorded in IMS prototype are classified not only by belonging to specific IS subsystem but in accordance with OSI model. This classification allows to connect the incident with OSI model level where it happens. One can give an example of incident distribution by levels:

- Physical level: twisted pair integrity is damaged.
- Channel level: no network connection is available due to the error of network driver adapter
- Network level: the path to the server is not found.
- Representative level: error of connection to remote work table when the client and server use incompatible coding levels.
- Application level: Web server Domino is not activated.

The user of IMS prototype can due to the similar distribution not only obtain the subset of incidents capable to lead to IS malfunction but sequentially looked through searching basic cause beginning from physical level and completing by application level.

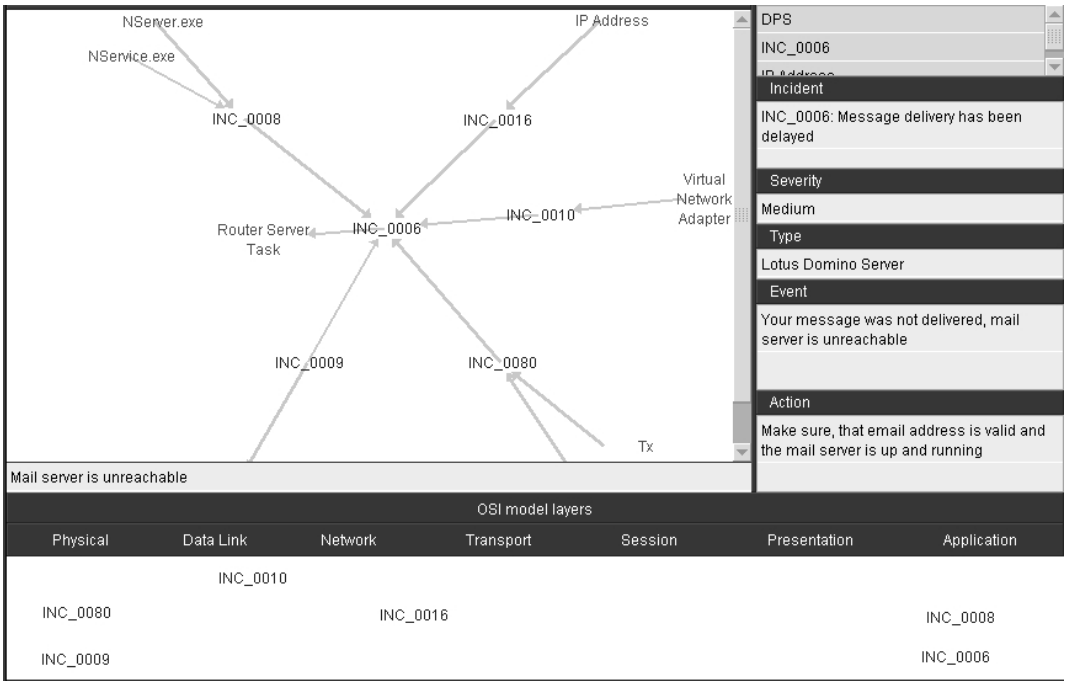

Fig. 2 – Presentation containing the incident description as central object

Incident distribution by levels of OSI model is accessible for the user in presentations where incidents are selected as objects. All incidents selected for such presentation are additionally presented in panel «OSI model levels» located under navigation panel (Fig.2). The distribution is performed according to the value of service field "osi" filled during incident recording

4. CONCLUSIONS

The considered prototype of incident management system based on ontological approach principles is designed to support the decision - making by experts responsible for information system operation and management. The information about previous incidents and methods of their settlement recorded by prototype tools can be used many times later on in case of similar or one-type incidents, this allows to improve the initial classification accuracy and reduce the time of their settlement.

The ontological approach use allows to formalize and structure unique knowledge of IS operation got by specialists during its operation. For structuring and sorting out data on recorded incidents and for search the classifiers of subject ontology are used , the classifiers are made in the basis of structural approach and OSI model.

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ABOUT A PROBLEM OF USING LAPLACE OPERATOR FOR IDENTIFICATION OF INDISTINCT CONTOURS

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The problems of applying of Laplace operator for identification of contours are analyzed. In this article recommendations about use of the Laplace operator for identification of indistinct contours are made. Examples of practical realization of approach are given.

Keywords: digital data processing, indistinct contours, Laplace operator, Wiener filtration, Fourier transform, gamma correction, histogram equalization

Currently range of tasks associated with the digital processing of images with text fragments are expanded. It is obvious that identification becomes impossible at essential loss of quality of images. Previously carry out correction of an analyzed image with histogram equalization and gamma correction [1]. This digital processing is directed on change of brightness and contrast.

After that the image has to be subjected to deconvolution for the purpose of increase of its informational content.

By term "deconvolution" designate inverse convolution operation for images. Convolution is based on representation of the image in the form of function of two variables $z=f(x, y)$ with its description by means of discrete direct Fourier transformation. The image subjected to filtration, for example, Wiener filtration [2] for the purpose of suppression of noise is used. Then the image subjected to the deconvolution based on the inverse Fourier transformation can be received. Discrete Fourier transform allow generalization on a two-dimensional case. The approach is called frequency approach. The analysis of filters of a deconvolution is represented in [3].

Alternative to frequency methods is the class of spatial methods of a deconvolution. Such methods for increase of informational content of image are oriented on allocation of object's borders and direct manipulations to image pixels. Good results are shown by the approach based on using of the Laplace operator (1) [1].

$$\nabla^2 f(x,y) = \frac{\partial^2 f(x,y)}{\partial x^2} + \frac{\partial^2 f(x,y)}{\partial y^2} \tag{1}$$

For computer realization discrete versions Laplace operator (2,3) are applied.

$$\nabla^2 f(x,y) = \left[f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1)\right] - 4f(x,y) \tag{2}$$

$$\begin{aligned}\nabla^2 f(x,y) = [&f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1) + f(x+1,y+1) + \\ &+ f(x+1,y-1) + f(x-1,y+1) + f(x-1,y-1)] - 8f(x,y)\end{aligned} \tag{3}$$

Results of application Laplace operator (2) are presented in fig. 1.

Figure 1 – Increase of informational content of image with text fragments by means of application Laplace operator (2).

Thus it should be noted that indistinct text fragments aren't restored (fig. 2).

Figure 2 – Increase of informational content of image with fragments of indistinct text by means of application Laplace operator (2).

By using Laplace operator (3) similar results was given. Repeated applying of Laplace operator leads to emergence of artifacts on the image at minor improvement of its quality (fig. 3).

Figure 3 – Increase of informational content of image with fragments of indistinct text by means of repeated application of Laplace operator (2).

At the same time iterative approach to the solution of an objective leads to increase of informational content of the image. This approach assumes image normalization and suppression of noise after each applying of Laplace operator. Experiment is made by Grishin D. V.

Figure 4 – Increase of informational content of image with fragments of indistinct text by means of repeated application of Laplace operator (2) with step-by-step normalization.

Thus, the technique of increase of informational content of image has to assume iterative approach to the solution of a task. This approach includes on each step algorithms of histogram equalization and gamma correction of the image [1] and also algorithms of a filtration [2, 3].

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MAIN PIPELINES DIAGNOSIS METHODS CLASSIFICATION

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The issue is devoted to the diagnosis of main pipelines defects. The issue consists of description of diagnosis methods according to leading oil and gas companies standards and classification of methods based on used diagnosis and monitoring technologies.

Keywords: methods of diagnosing, pipelines, defects, remote sensing, classification, pattern recognition

The problem of main pipelines defects diagnosis has defining character in the monitoring of their health. On the basis of pipeline health data decisions on expediency of its use continuation, repair or replacement the pipeline site are made. Use of specialized technical means, technologies and methods of diagnosis is urged to increase quality and to reduce laboriousness of main pipelines monitoring.

The main objectives of control and diagnosis of main pipelines are: definition of technical condition on the basis of complex monitoring in the course of creation and operation of gas transmission system, the assessment and forecasting of technical condition dynamics for the purpose of ensuring reliable and safe operation of the gas transmission system.

According to [1] there are the methods of main pipelines diagnosis:

– aerospace survey of the main pipelines using color, polyzonal, infrared, radio-frequency and other methods of survey;

– control of cathode protection potential of the pipeline systems, exercised at land inspections and from helicopters;

– instrumental pistons passing in the pipelines for assessment and measurement of corrosion defects on an internal and external surfaces of pipes and existence of dents and elongations.

– surface inspection of separate sites of pipelines with use of methods of nondestructive control (ultrasonic diagnosis, thickness gauging, acoustic-emissive diagnostics, etc.);

– inspection from vessels for underwater pipelay with use of hydroacoustic geometry tools;

– laboratory researches of materials properties, welded connections, insulating covers, etc.;

– land deformability researches of underground, land and elevated pipelines sites using of geodetic and laser means;

– diving inspections siphon pipelines transitions;

– visual inspection of pipelines internal part and fittings using fiber-optic means;

– x-ray, ultrasonic and magnetographic control methods of welded seams at construction and repair of pipeline systems;

– test and retest of pipelines sites by hydraulic or pneumatic methods of internal pressure.

These methods can be grouped according to the classification given on figure 1 [2].

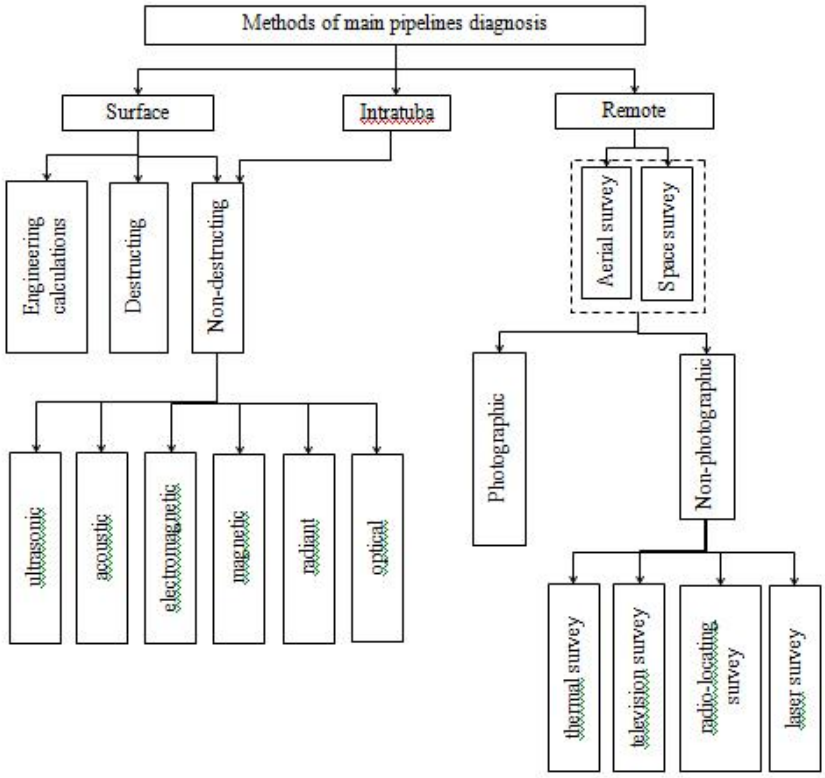

Figure 1. Classification of the main pipelines diagnosis methods

Surface pipes quality control doesn't cause special difficulties and is carried out by engineering calculations and methods of destructive and nondestructive control.

Engineering calculation methods are focused generally on an assessment of products operational durability resources at the stage of their design and production. The choice of optimal constructive decisions, materials and production processes allows to predict strength characteristics of future products with high precision.

Destructive control methods of strength characteristics are based on researches of final or partial fracture processes of products and mechanisms at impact of physical activities of various orientation, intensity, action time, etc.

Methods of nondestructive control of materials develop especially intensively: ultrasonic, acoustic, electromagnetic, magnetic, radiation, optical, etc. The physical and chemical phenomenas occurring in solid bodies at impact of mechanical loadings are the basis for these methods: change of ultrasonic fluctuations distribution speed or their ability to be reflected from limits of the environments with various acoustic resistance; change of electromagnetic characteristics in sites of controlled object non-uniformity as a result of magnetoelastic effect, dispersion of a magnetic flux, manifestation of magnetic anisotropy, change of magnetic field size or losses of vortex currents; dispersion and absorption of x-ray and gamma beams in environments with various density.

Methods of nondestructive control can be applied in pipelines intratubal diagnosis and other means:

– television visual and measuring control method for superficial defects identification on an internal surface of pipes: like violation of a uniformity of pipe metal and joints (cracks, stratifications, captivities, rags, etc.) with measurement of their geometrical sizes;

– method of an ultrasonic thickness gauging for measurement of pipe walls thickness and definition of a thickness irregularity of pipes edges;

– method of magnetic control for detection of defects like violation of a pipe metal and joints uniformity at internal and external pipe surfaces, and also in pipe walls [3].

Remote sensing methods consist in collection of information about object of diagnosis by means of registering device which isn't in direct contact with this object. By the form carriers of survey means they distinguish space and aerial survey [4].

Specifics of space survey are caused by its visibility, integration of objects (natural generalization) and possibility of studying of the nature and geotechnical systems at different levels of generalization. Results of space survey (in combination with results of aerial survey) first of all have to be used at thematic mapping of the studied territory. Such combination allows to make the most part of works in laboratory conditions, to minimize the field researches, also the field researches become more similar to control supervision, instead of routes survey.

Aerial survey is a district survey by special means (the camera, the thermal imager, the scanner, etc.), established on the aircraft. Planes, helicopters, free and fastened balloons and airships, pilotless radio-controlled mini-planes and mini-helicopters, motor-hang-gliders can be used for aerial survey works. The plane (helicopter) used for aerial survey, has to be provided with flight navigation equipment and also have photohatches and other devices for survey equipment placement and operation, be provided with a necessary complex of survey means with a demanded accuracy.

Depending on the used range of electromagnetic waves and receiver type, remote researches are subdivided into big groups of methods: photographic and non-photographic.

Photographic methods of survey are the most universal and most widely used type of remote sensing now. Efficiency of photographic survey application is connected with high degree of spatial and spectral resolution that is of special importance in determination of change regularities of operation technical specifications and pipeline health. Thanks to large volume of received information, relative simplicity of application, a sufficient level of development, photographic methods took a leading place in a complex of works on studying of a pipeline geotechnical systems health. Classical methods of obtaining images of a surface by means of the camera with its registration using method of direct optical projection are only part of a complex of methods of remote sensing. Non-photographic types of survey - thermal infrared, microwave, television, radar, scanner, etc. can be used as special, allowing to solve narrower circle of specific tasks methods. Results of these surveys are used when their application yields positive result.

There are methods of non-photographic survey: thermal, television, laser and radio-locating.

Depending on the used range of electromagnetic waves among thermal methods of shooting distinguish infrared thermal and radiothermal (microwave) surveys. It is expedient to apply thermal surveys to research manifestations of geodynamic and hydrogeological processes on pipelines routes connected with moistening, water saturation and heat transfer (flood, bogging, permafrost thawing, etc.). Such sites are found in thermal pictures by thermal anomalies. There is a possibility of identification of pipelines sites naked and close to ground surface.

It is expedient to apply television survey from the artificial satellites to control development of geodynamic processes around routes of pipelines, to detect and to assess scales of large emergencies. TV-survey is performed in a mode of direct transfer of images to land stations if the aircraft (usually space) is in a zone of their reception, or in a storing mode. In the second case magnetic recording of video signal is performed. At the subsequent passing of an artificial satellite in a land reception station zone of work written-down information is transferred to Earth by radio channels. The transmitted electric signals will be transformed to a digital form or to the image on the display.

Laser survey is based on laser ability to give powerful radiation in narrow zones of a range. Laser survey can be applied: for obtaining images of a district surface; search of leakages of a pumped-over product; the district and air pool pollution assessment; condition of reservoirs bottom and underwater pipelines sensing. Possibility of pumped-over product leakages detection, the district and air pool pollution assessment is based on ability of the laser to give powerful radiation in narrow zones of absorption and emission of substances. Signals in these zones are registered by special sensors. A large number of laser gas analyzers are based on this principle. Application of laser survey for research of a condition reservoirs bottom and underwater pipelines is based on use of laser radiation power in a green zone of a range where water is almost transparent substance. Depending on power, the frequency of impulses and the condition of water, depth of probe reaches 40 m with discretization of bottom marks values measurement and the pipeline of 20 cm along a route axis.

Radio-locating survey is the active method of sensing based on use probing signals reflection, radiated by the transmitter from a terrestrial surface, and is conducted in the range of 0.3-100 cm (100 GHz - 300 MHz). The main advantages of radio-locating survey in comparison with other types of remote sensing are: independence of weather conditions and time of day; independence of resolution from distance to objects; big strip of capture on the district (from small heights); possibility of the emerged pipelines detection by radar contrasts; possibility of a digital data recording at the time of shootings and its transfer from a carrier board on a communication channel on considerable distances. Shortcomings of radio-locating survey are lower resolution, the small scale of the image, an image distortion.

So, results of pipelines remote sensing are the images received in various areas of a range of electromagnetic waves. Processing of these images consists in images quality improvement and monitoring results assessment.

Images quality improvement is carried out automatically by means of the specialized software. The set of methods and the means realizing images quality improvement is at resent developed subsequently and solves certain problems, arising at an stage of monitoring results assessment [5].

The monitoring results assessment consists in research of images for defects regarding signs. Often it is made manually by the engineer possessing the required qualification. However, large volume of obtained data, high degree of image uniformity and weak discernibility of objects complicate and slow down assessment process. Therefore it is offered to use images recognition technologies for narrowing of defects search area.

Elements of the images recognition theory are often used at processing data of remote sensing; there are ready methods and the decisions which are using in certain narrow areas. But it is necessary to transform available methods almost completely when it is needed to change the recognition purposes. So, for the recognition problem solution it is necessary to define classes of recognizable objects and the signs basing on which these objects can be classified, choose a method on the basis of classes quantity and classes discernibility degree. These stages are the main objectives for further work within this research.

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INFLUENCE OF THE QUALITY OF TECHNICAL SYSTEMS ON THE RELIABILITY CHARACTERISTICS OF THEIR ELEMENTS

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Considered are the questions of influence of quality of Technical Systems on the reliability of their Elements. It is shown that the improvement of the quality Systems affect the structure of the models of field failure rate. An example of the influence of quality of Cooling System of the model structure of the failure rate for class "Filters" and recommendations to improve the accuracy of this model.

Keywords: quality, reliability, technical systems, failure rate

This study (research grant № 14-05-0038) supported by The National Research University - Higher School of Economics' Academic Fund Program in 2014. As is known, the reliability of the Elements of Cooling Systems of Electronic Equipment is largely dependent on the regime of their use. The analysis of methods and means of reliability prediction procedures for mechanical equipment of such systems is provided in [1-3].One of the components of such systems are the Filter Elements. Figure 1 shows a typical circuit Cooling System, which uses a Filtering Element.

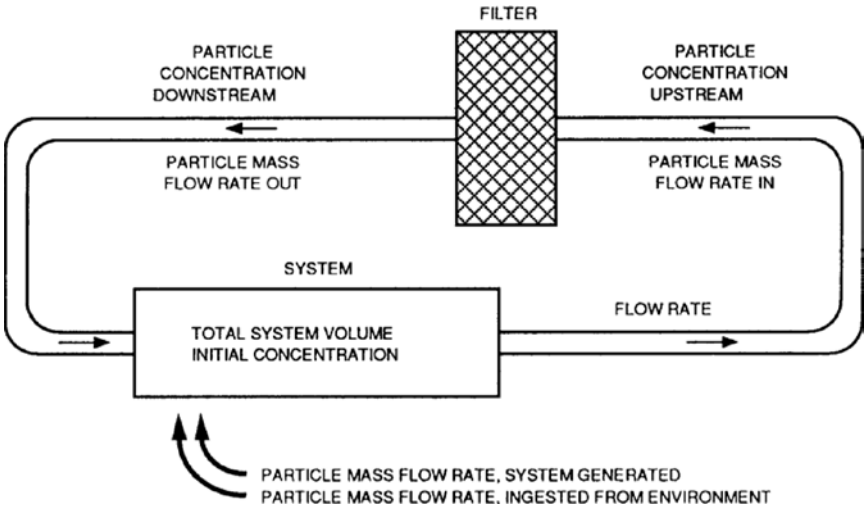

Figure 1 - Simplified Fluid System containing Filter

Let's consider the mathematical model of the failure rate (λ_F) for Filters (Filter Elements), contained in the American standard of NSWC-98/LE1 [4], developed by specialists of Carderock Division of the U.S. Navy:

$$\lambda_F = \lambda_{F,B} \cdot C_{DP} \cdot C_{CF} \cdot C_V \cdot C_T \cdot C_{CS} \cdot C_E \quad (1)$$

where: $\lambda_{F,B}$ - base failure rate of the Filter; C_{DP} - multiplying factor which considers the effects of the Filter differential pressure; C_{CF} - multiplying factor which considers the effects of cyclic flow; C_V - multiplying factor which considers the effects of vibration; C_T - multiplying factor which considers the effects of temperature; C_{CS} - multiplying factor which considers the effects of cold start-up conditions; C_E - multiplying factor which considers the effects of incompatible fluids and materials.

Figure 2 shows the typical structure of such Element.

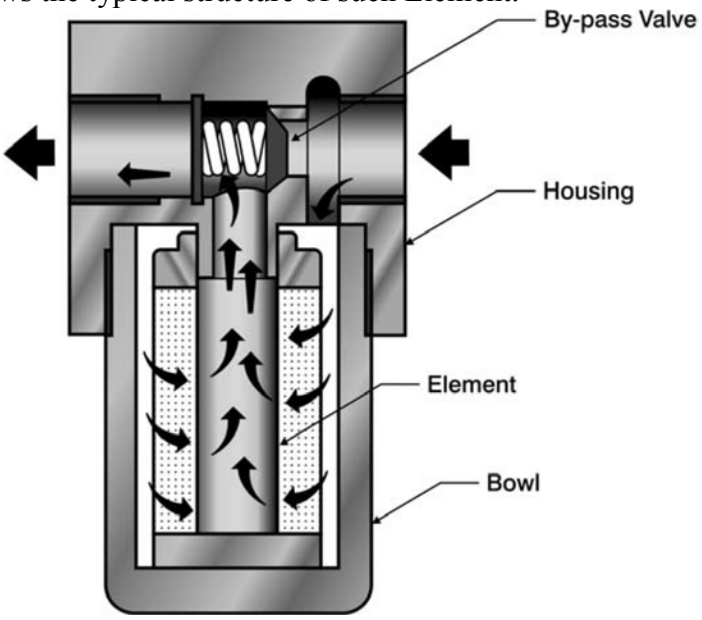

Figure 2 - Typical Filter Construction

The value $\lambda_{F,B}$ in the formula (1) is assumed constant for all types of Filters:

$$\lambda_{F,B} = 2,53 \cdot 10^{-6}.$$

The value of the multiplying factor C_{DP} is calculated by the model:

$$C_{DP} = \frac{P_i' \cdot a^2 - P_o' \cdot b^2 + \dfrac{a^2 \cdot b^2 \left(P_o' - P_i'\right)}{r^2}}{P_i \cdot a^2 - P_o \cdot b^2 + \dfrac{a^2 \cdot b^2 \left(P_o - P_i\right)}{r^2}}, \tag{2}$$

where: P_i' - inside pressure; P_o' - outside pressure; P_i - inside pressure in nominal operating mode; P_o - outside pressure in nominal operating mode; a - inside radius; b - outside radius; r - radius, corresponding to maximum stress.

The value r in the model (2) can only take one of two values: a or b.

The value of the multiplying factor C_{CF} is calculated by the model:

$$C_{CF} = 1 + \frac{1,7 \cdot a^2 \cdot \left(2 \cdot P_{i\max}' - 0,3 \cdot P_{i\min}'\right) - 0,7 \cdot P_{o\max}' \cdot \left(a^2 + b^2\right) - 0,3 \cdot P_{o\min}' \cdot \left(a^2 + b^2\right)}{1,4 \cdot T_S \cdot \left(b^2 - a^2\right)}, \tag{3}$$

where: $P_{i\min}'$ - minimum inside pressure; $P_{i\max}'$ - maximum inside pressure; $P_{o\min}'$ - minimum outside pressure; $P_{o\max}'$ - maximum outside pressure; T_S - tensile strength of filter media.

The value of the multiplying factor C_V depends on the characteristics of the vibration impact on the filter on the object installation and is determined according to the standard NSWC-98/LE1 [4]/

For *System Type* Aircraft and Mobil:

$$C_V = 1,25 \tag{4}$$

For other *System Type* value of the multiplying factor C_V is assumed to be 1.

The value of the multiplying factor C_T for $150 < T < 250$ is calculated by the model:

$$C_T = \left(\frac{T}{200}\right)^{-4,97}, \tag{5}$$

where: T - fluid temperature in the working mode.

For $T < 150$ value of the multiplying factor C_T is assumed to be 1.

The value of the multiplying factor C_{CS} is calculated by the model :

$$C_{CS} = \left[\frac{\nu(T_{coldstart})}{\nu(T_{normal})}\right]^x, \tag{6}$$

where: $\nu_{coldstart}$ - viscosity at cold start temperature; ν_{normal} - viscosity at nominal operating mode; $T_{coldstart}$ - cold start temperature; T_{normal} - nominal operating mode temperature; x - exponent depending on the type of fluid.

The value of the viscosity and exponent x is defined according to the model (see figure 3):

FLUID	EXPONENT x	VISCOSITY, ν
SAE 10W-30	0.20	$17.4 - 0.5T + 0.0060T^2 - 0.000036T^3 + 1.07E\text{-}07T^4 - 1.25E\text{-}10T^5$
KEROSENE	0.46	$0.04 - 3.86E\text{-}04T + 1.80E\text{-}06T^2 - 3.04E\text{-}09T^3$

Figure 3 - Value of the exponent x and the temperature dependence of viscosity

For other types of liquids value of the multiplying factor C_{CS} is assumed to be 1.

The value of the multiplying factor C_E is calculated by the model (see figure 4):

SYSTEM FLUID	CONTAMINANTS	C_E
Kerosene	Water	1.0 + 0.61 (percent water volume)
Hydraulic Oil	Water	1.0 + 2.64 (percent water volume)

Figure 4 - Model multiplying factor C_E

For other types of fluids and contaminants value of the multiplying factor C_E taken equal to 1.

Analysis of the above models showed that only options $\lambda_{F,B}$, P_i, P_o, T_S and ν_{normal} directly or indirectly depend on the specifics of constructive and technological performance of the Filter, and all the rest - from the regime of its use in the Cooling System [5, 6].

When, therefore, improvement of the Cooling Systems has led to the fact that the probability of pollutants in the working fluid has been reduced almost to zero, as amended

standard NSWC-06/LE10 [7] of the mathematical model of the failure rate (1) multiplying factor C_T, and C_E and their mathematical models were withdrawn:

$$\lambda_F = \lambda_{F,B} \cdot C_{DP} \cdot C_{CF} \cdot C_V \cdot C_{CS} . \quad (7)$$

At the same time expanded the nomenclature of types of liquids (see figure 5), for which we can calculate the value of the multiplying factor C_{CS}.

Liquid	Viscosity in Centistokes, ν								X
	0 C	20 C	40 C	60 C	80 C	100 C	125 C	150 C	
Water	1.8	1.0	0.75	0.56	0.35	0.28			0.2
Sea water	1.9	1.1	0.87						0.2
Gasoline, 0.68 s.g.	0.51	0.42	0.35	0.30					0.3
Kerosene, 0.81 s.g.	3.7	2.3	1.6	1.2	0.96				0.2
Light lubricating oil, 0.91 s.g.	390	96	34	16	8.7	5.4			0.2
Heavy lubricating oil, 0.91 s.g.	3492	500	123	43	20	10			0.7
SAE 10 oil	555	122	41	14	8.7	5.4	3.3	2.2	0.5
SAE 20 oil	1141	213	65	22	11	6.8	4.4	2.8	0.6
SAE 30 oil	2282	358	101	33	15	9.4	5.5	3.6	0.7
SAE 40 oil	4640	624	137	51	26	13	7.8	5.0	0.8
SAE 50 oil	8368	1179	251	76	32	17	9.5	6.4	0.9
SAE 60 oil	15215	2206	380	107	38	20	11	7.5	1.0
SAE 70 oil	23203	2853	456	137	49	25	14	8.5	1.1

Figure 5 - Temperature dependence of viscosity and value of the exponent x

Further improvement of quality Cooling Systems has led to that level and pressure pulsation flow of liquid from the pump was negligible, so in the next edition of the standard NSWC-10 [8] of the mathematical model of the failure rate (7) multiplying factor C_{CF} and its mathematical model (3) were seized:

$$\lambda_F = \lambda_{F,B} \cdot C_{DP} \cdot C_V \cdot C_{CS} . \quad (8)$$

In addition, improvement materials filters led to the fact that the effect of the surface application of the maximum pressure was also insignificant. This simplified model of the multiplying factor C_{DP}, which is reflected in the revised standard NSWC-11 [9]:

$$C_{DP} = 1,25 \cdot \frac{P_o}{P_R} , \quad (9)$$

where: P_o - operating upstream filter pressure; P_R - rated filter pressure.

The standard NSWC-11 [9] in the model (8) once again returned to the multiplying factor C_{CF}:

$$\lambda_F = \lambda_{F,B} \cdot C_{DP} \cdot C_V \cdot C_{CS} \cdot C_{CF} . \quad (10)$$

The value of the multiplying factor C_{CF} is selected depending on the type of pore size filters materials and surge frequency (see figure 6).

Pore size type	Surge Frequency, Hz	C_{CF}
Uniform	0 - 0,1	1,0
	0,1 - 0,5	1,2
Non-uniform	0 - 0,1	1,2
	0,1 - 0,5	1,5

Figure 6 - Value of the multiplying factor C_{CF}

We will notice that models of multiplying factors C_{DP} and C_{CF} the standard NSWC-11 [9] contradict definition $\lambda_{F,B}$, which characterizes failure rate of the filter in normal conditions at a rated load. In other words, at value C_{DP} for $P_o = P_R$ it has to be equal 1, also as well as value at C_{CF} for $Surge\ Frequency = 0$ Hz.

Then $\lambda_{F,B}$ will have the following values (see figure 7).

Filter type	$\lambda_{F,B} \cdot 10^6$
Uniform pore size type	3,1625
Non-uniform pore size type	3,795

Figure 7 - Value of the base failure rate

Thus value C_{DP} is determined by model:

$$C_{DP} = \frac{P_o}{P_R}, \tag{11}$$

and value C_{CF} for $Surge\ Frequency = 0{,}1 - 0{,}5$ Hz is determined by model:

$$C_{CF} = \begin{cases} 1{,}2 - for\ Uniform\ pore\ size\ type \\ 1{,}25 - for\ \text{Non-}Uniform\ pore\ size\ type \end{cases}. \tag{12}$$

For other ranges of frequencies value of the multiplying factor C_{CF} taken equal to 1.

Thus, parameters P_o, $System\ Type$, $T_{coldstart}$ and $Surge\ Frequency$ in model (10) characterize quality of Cooling System. The peculiarities of the design-technological Filter in nominal operating mode ($\lambda_{F,B}$) are defined only parameter $Pore\ size\ type$ (see figure 7). Therefore, when using model (10) for increase of accuracy of calculations of $\lambda_{F,B}$ it is necessary to use value of $MTBF$:

$$\lambda_F = \frac{C_{DP} \cdot C_V \cdot C_{CS} \cdot C_{CF}}{MTBF}, \tag{13}$$

where: $MTBF$ - Mean Time Before Failure of the Filter in a nominal mode.

Thus, comparing models (1), (7), (8), (10) and (13), it is possible to draw a conclusion that the structure of model of failure rate for Filters is defined only by quality of Liquid Systems in which they are applied. And in process of improvement of these systems the structure of models becomes simpler.

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PECULIARITIES OF MEASURING SIGNALS PROCESSING DURING DETAIL'S DYNAMIC COUNTERBALANCING

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The question of processing of sinusoidal signals from piezoelectric sensors of a dynamic balancing stand, summarized with high level noise, is discussed. Special methods and devices for amplification and digital filtration the signals are used during the signals' processing.

Keywords: counterbalancing, measurement, signal, noise, filtration, frequency of detail's rotation.

Being balanced a dynamically unbalanced part made in a form of long rotation rigid body is considered to be a completely balanced rigid rotor, and point unbalanced mass are fastened in its correction planes which are perpendicular to the rotor axle. According to literature [1] and other sources it is known that it is enough to measure load or vibration of supports of a rigid rotor at a constant rotation frequency in order to determine two disbalance vectors operating in two correction planes and determining its dynamic disbalance completely. As well as any vector disbalance is determined by a numerical value and an angle which determines the position of the rotor coordinate system. In order to ensure dynamic balancing of good quality obtained experimental data about disbalance parameters used for the consequent trim analysis are to be precise and creditable. During the trim experiment performed on the balancing stand, disbalance parameters in the correction planes are calculated from the results of the vector parameters measurements – values and angles –vibration of supports which a controlled part rotates around a fixed axle in.

In the low frequency vertical dynamic balancing stand designed for precise noncontact balancing of parts of "long" rotor types [2], rigid supports are made as two coaxel gas bearings fixed at a vertical pillar with resilient plane-parallel sheets. A disbalance measuring system consists of two piezoelectric sensors of a generator type force (one sensor is per each support), which are based in resilient elements of bearings, and a photoelectric sensor-marker of a disbalance phase (further – photosensor) which is also used for measuring rotation frequency of a controlled object [2, 3]. Signals are registered at a constant rotation frequency during a short period of time when fluctuation of the rotor rotation frequency does not exceed 0,6%–0,7% compared to the rated value. Registration is started up by a signal from the photosensor when an established operating rotation frequency is achieved at running-out of the controlled rotor after its preliminary spinup.

When rotor rotates information about its disbalance is transferred to the piezosensors of forces through air compressed layers dividing operating surfaces of the rotor and supports, gas bearings and resilient member. Those piezosensors generate electric signals which are proportional to the degree of the supports vibration. Not only rotor disbalance influences the supports, but also vibration (caused by forces variable within the wide frequency range)does. Spurious vibration can be caused by ovality, grained areas and other mechanical defects of operating surfaces of the rotor and supports, irregularity in air-gap clearance, acoustic vibration caused by repeated air reflection when air flows pass ells of dimensionally curved discharged lines, natural resonance of the vibrating system determined by vibrating masses, rigidity of resilient sheets and an air layer in the clearances, triboelectric effects in the instrument cables, and etc. Consequently a complex mixture of signals with a very wide scatter in terms of amplitudes reaches the vibration signals receiver, and this interferes with the disbalance parameters determination significantly. You can see the view and the frequency spectrum of the temporary instantiation of the typical measuring signal at the output of the force measuring piezosensor on the figures 1 and 2 correspondingly.

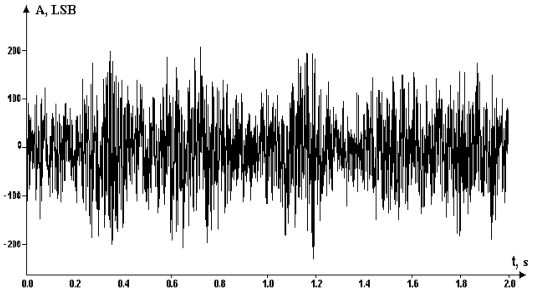

Fig. 1. A signal view

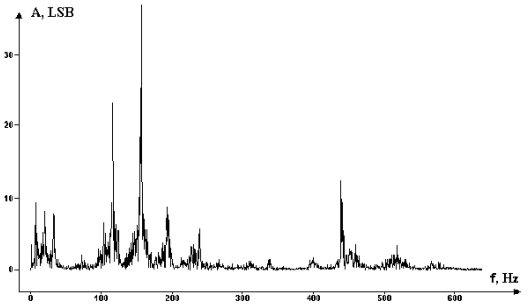

Fig. 2. A signal spectrum

A measuring computer system is used for selecting useful disbalance signals inciting at the operating rotation frequency of the controlled part. The main part of the system is personal computer (PC), also used for monitoring technological equipment during the experiment, and

for carrying out mathematical calculations. Special-purpose amplifying devices, frequency selective electronic devices, analog-to-digital conversation (ADC) devices, and also special-purpose methods of digital type signals processing with PC in each of two structurally identical measuring channels. Herewith the general efficacy and quality of balancing depends on the quality of the measuring channels heart of software significantly. You can see a measuring channel block scheme on the figure 3. The scheme instruments a typical algorithm of signal processing, including the following operations: reducing the value of the high output impedance and preliminary amplification of a comparatively weak output signal of a piezosensor, low-frequency filtration of the measuring signal components of a receiving for processing additive mixture with a spurious signal, signal multiplication and numeralization, elimination of zero offset and equipment zero drift, which exist among useful information inevitably, and determination of the useful signal with application of a digital filtering algorithm.

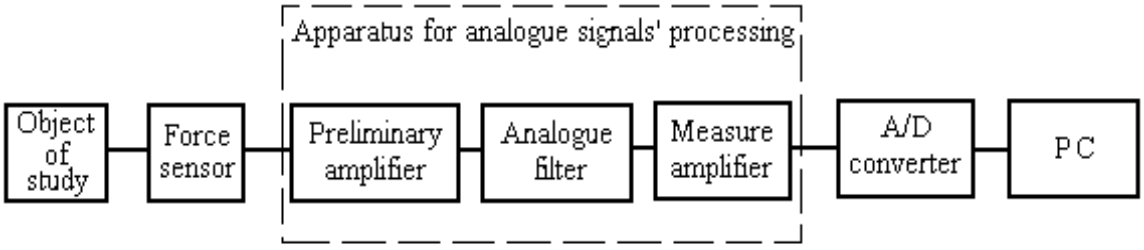

Fig. 3. A measuring channel structure

A digital filtering algorithm includes the following operations. First the initial signal is represented in the Fourier series, and the frequency characteristic of the selective filter is generated, the transmission frequency of the filter shall coincide with the operating rotation frequency of the controlled part. Then the frequency-domain presentation of the Fourier series is multiplied by the filter characteristic, and then the result of multiplication is processed according to the reverse Fourier presentation. On the figure 4 you can see a view of the typical signal registered in the PC memory after the analogue processing. On the figure 5 you can see the view of a digital component filtered with the Fourier filtration synchronously with the rotation frequency. This component is contained an information about unbalanced parameters.

Output channel information describing disbalance is represented by a sine signal which frequency coincides with the part rotation frequency. A signal amplitude measured in volts or digits units of A/D-converter is proportional to the disbalance value in the controlled correction plane, and the phase (that is frequency shift value measured in milliseconds relatively to the benchmark) is proportional to the disbalance angle expressed in grades. Herewith the signal benchmark is considered to be equal to 0.

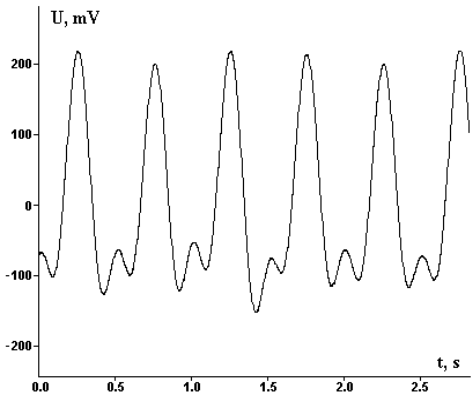

Fig. 4. A signal view after analogue filtration

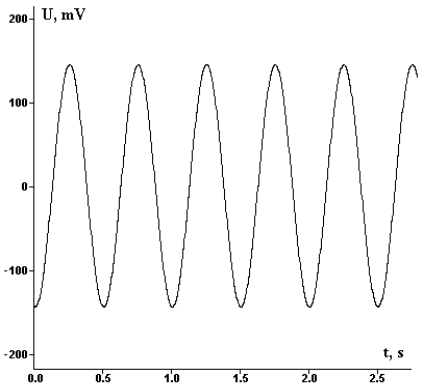

Fig. 5. A signal view after Fourier filtration

On the figure 6 you can see the view of one of the display forms of the software operator interface which ensures registration of two measuring signals after their analog processing performed online, and the digital processing resulted in the obtained sine signals parameters.

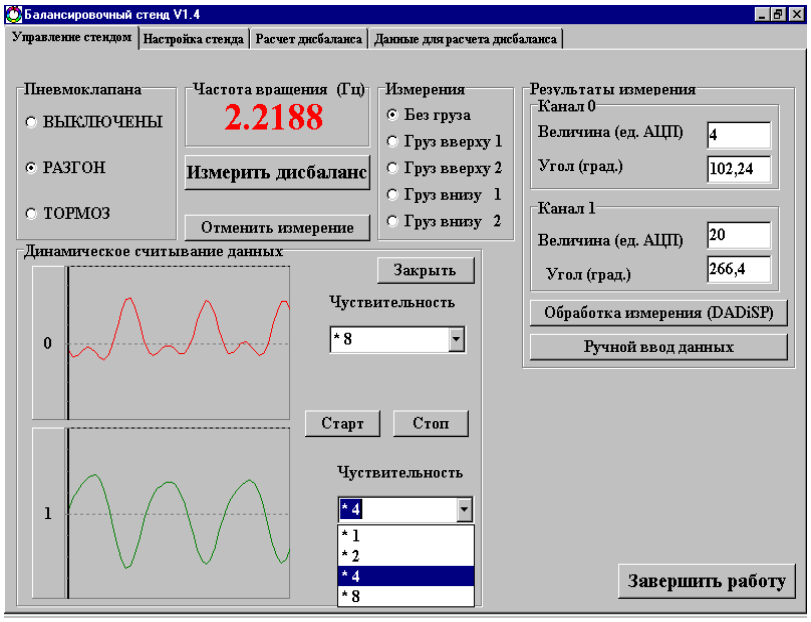

Fig. 6. A display form

However useful signals parameters of disbalance shall be considered as chance variables during the analysis as the required parameters values are unknown, and these values vary within certain ranges depending on the experiment. Errors of disbalance signals parameters are caused by unstability of analogue processing device parameters, measurement resolution, presence of the superious signal with the frequency having almost the same value as the operating rotation frequency, variability of rotation frequency signals and compressed air pressure used as working medium during the registration, and a number of other reasons. The results of the disbalance signals parameters measurement can be presented as follows:

$$x_i = x + \sigma + \theta ,$$

where x – is a real value of the measured parameter; σ and θ – an accidental and a systematic components of the total error of the parameter measurement correspondingly.

An adequate model of disblance is a Gaussian process. Gaussian processes are those having probability distribution density describing by the normal law. Systematic errors can be determined during the stand adjustment carried out before a balancing experiment for example [3], and can be eliminated with the corresponding single-error corrections almost completely. Accidental errors of amplitude and disbalance signal phases measurements can be estimated for each channel separately and tentatively in the course of the primary metrological certification and during the following verifications of the stand with a standard rotor and a set of calibrated sample weights. Such estimations shall be made based on the results of numerous measurements of disbalance signals parameters within the full range of possible variations of controlled parameters of part disbalance succeeded by the final processing of the measurement results [4]. Obtained metrological characteristics can be included into the stand card and be used in future during balancing experiments for calculation of dynamic disbalance of a controlled part and determination of errors of obtained disbalance parameters.

The considered method of processing measuring signals and estimation of signals parameters measurement error has been tested, and allowed to achieve positive results on a low-frequency vertical dynamic balancing stand with gas bearings.

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CREATION OF OBJECT AND FUNCTIONAL MODEL OF DIFFICULT OPERATIONAL AND TECHNOLOGICAL OBJECT.

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PENZGTU

The description of information structural model of an example of the difficult operational and technological object, has to be coordinated by the object and functional model called in work on level of complexity with perception opportunities their performers of operation and reflection of structural and functional properties. For this purpose structuring descriptions and the corresponding division of ideas of studied object on the object and structural and functional and graph description is required. Division of descriptions of object on extent of specification of displayed properties and characteristics of object is cornerstone of object and structural approach to design on the basis of consideration of hierarchical levels (abstraction levels) representation of structural images (a pyramid of knowledge) objects. At each hierarchical level the concepts of systems and elements are used.

At the level of 1 (top level) the difficult object of S is considered as system S from n of the interconnected Si elements. Each of elements in the description of level 1 represents also difficult object which is in turn considered as a subsystem of Si at the level of 2. Elements of subsystems of Si are objects of Sij, j = l, 2... Mi (M – quantity of elements in the Si system description). As a rule, allocation of the Sij elements happens on a functional sign. Similar division proceeds up to receiving at some level of elements which Such elements aren't subject to further division are called basic.

Thus, the principle of hierarchy means structuring ideas of objects on degrees of detail of descriptions, and the principle of decomposition of a blochnost) – splitting representations of each level into a number of components (blocks) about possibility of the porazdelny (block) description of objects of Si at the level of 1, objects of Sij at the level of 2, etc.

In technical systems Basic Elements are details.

Except a partition of descriptions on degree of a detail of reflection of properties of the object generating hierarchical levels, use decomposition of descriptions on nature of displayed properties of objects with use of ontologic approach [1-4].

Such decomposition leads to emergence of a number of aspects of descriptions within the declarative block, with orientation to restoration operations.

The largest are:

The organizational aspect is connected with display of the main information processes of the organization of repair.

The constructive (parametrical) aspect is connected with realization of results of functional modeling, i.e. with definition of geometrical forms of objects, their relative positioning in space and the description of the parameters providing functioning of objects.

The operational aspect is connected with processes of receiving, logical processing and storage of information on a condition of system, a choice of parameters for control of working capacity and localization of malfunctions.

The operational aspect is based on functional and parametrical aspects and is their logical end.

Technological the aspect is connected with the description of characteristics of objects from the point of view of technology of their restoration, methods, forces and means for the restoration organization.

Association of functional, design (parametrical), diagnostic and technological aspects in multilayered structure of declarative blocks. The SETO functional and graph model is understood as the description of processes of functioning, diagnosing and SETO restoration by creation by means of the COMPUTER of the models reflecting the functional description of a design, communications of subsystems (blocks) and their fitness to restoration through their information characteristics and created flows of information. Thus, creation of the SETO object and functional model includes two stages:

– development of the SETO object and structural model with allocation of hierarchical levels of a design and the description of organizational, design (parametrical), technological and diagnostic aspects with knowledge base use on aspects of the description of production subject domain (BZ PEO);

– development of functional and graph model of technological effectiveness of restoration of SETO with the description of fitness of elements (blocks) to restoration.

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EXPANDING COMMERCIAL SPICE POSSIBILITIES IN THE FIELD OF EXTREME ENVIRONMENT ELECTRONICS DESIGN BY USING NEW BJT AND MOSFET MODELS WITH ACCOUNT FOR RADIATION INFLUENCE

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The possibilities of commercial SPICE are expanded in the new field—space environment electronics design. For this purpose, the set of BJT and MOSFET models with account for radiation influence is included into commercial SPICE device library. The characteristics of devices and circuits subjected to space radiation exposure (gamma-rays, protons, neutrons, electrons, heavy ions) are presented and examined with emphasis on application for radiation hardened electronics systems.

Keywords: silicon bipolar transistor (BJT), silicon-germanium heterojunction bipolar transistor (HBT), metal-oxide-semiconductor field-effect transistor (MOSFET), ionizing radiation, SPICE model, computer aided design (CAD), circuit simulation.

Introduction

The present-day market of extreme environment electronics includes satellite systems supporting the global communications infrastructure, various weapons systems, space exploration platforms, various sensors systems, space-based remote imaging systems for climate and resource mapping, particle physics detectors and measurements, health imaging systems, etc. Evidently, it will grow in the future.

It is generally a true statement that conventional electronic devices put into extreme environment systems (spacecraft, satellite, etc.) will quickly fail due to exposure to radiation. Therefore, the new electronics design methods using changes to device, circuit and/or system architecture (termed “hardening-by-design”) are necessary.

The commercial software tools based on SPICE platform are widely used in Computer Aided Design (CAD) systems [1]–[4] for electronic circuits and equipment fabricated for different applications. However, conventional SPICE-like software tools are not valid for extreme electronics design.

In this paper, the innovational approach expanding commercial SPICE possibilities in the field of Extreme (Space) Environment electronics design is suggested. The key point of this innovation is a new set of BJT and MOSFET models with account for radiation effects that is built into SPICE device model library.

The strategy of SPICE device models development for extremal electronics

The strategy of development of device models with account for radiation effects is presented in Figure 1. To realize this strategy, a combination of two universal methods

is used: adding new circuit elements to a standard SPICE model of semiconductor device and introducing mathematical expressions for radiation dependent model parameters.

The following types of radiation influence are of most importance for space electronics: total ionizing dose (TID) of gamma-rays, protons, neutrons, electrons, and heavy ions. The physical effects caused by these irradiations are included into standard SPICE BJT and MOSFET models. The models are developed for low-, middle- and power bipolar and MOS devices fabricated on the base of different semiconductor structures: Si BJT, SiGe HBT, conventional MOSFET, SOI/SOS MOSFET, DMOSFET, GaAs BJT, MESFET, and HEMT.

Such strategy allows expanding the commercial SPICE possibilities into the field of extreme environment electronics design.

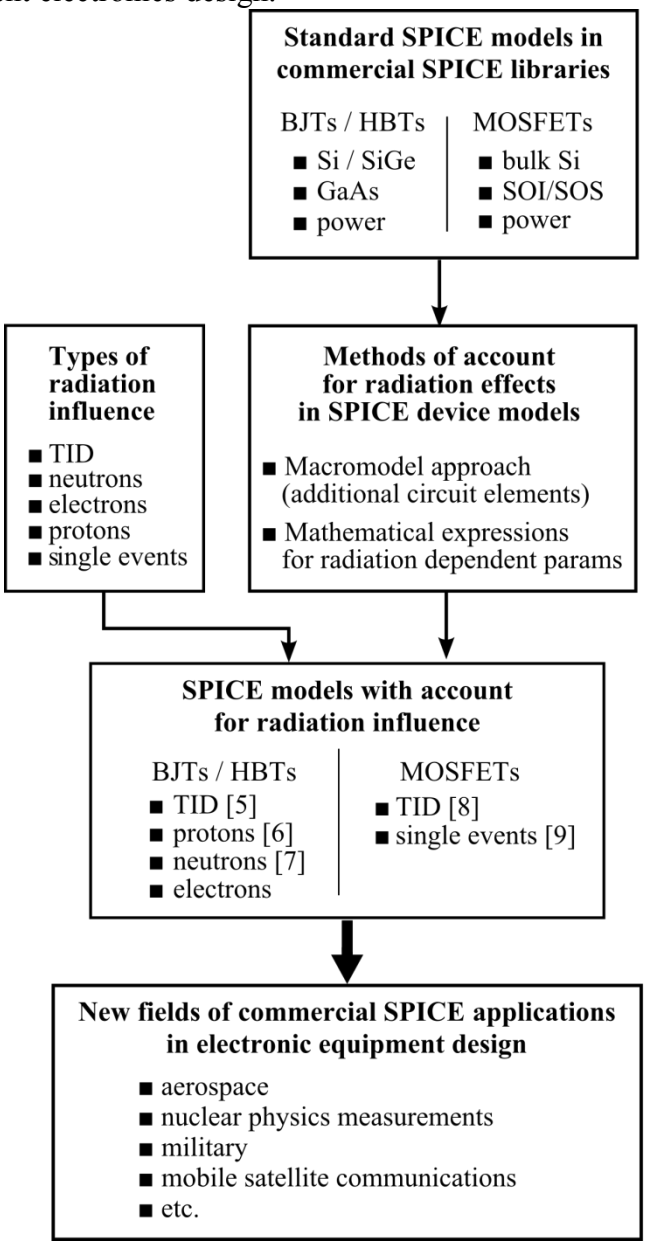


Figure 1. The schematic presentation of the strategy of development of SPICE device models taking into account radiation effects

Compact models for Si BJT/SiGe HBT with account for radiation influence and their application for circuit simulation

Conventional electronic circuit components (behavioral current and/or voltage sources, or diodes) with radiation dependent parameters were added to the standard SPICE model for Si BJT/ SiGe HBT (see Fig. 2). Additional components *Ib_cor, Icor, Vcor* are responsible for increase of base current, decrease of saturation current and shift of collector current in the saturation region and in the pre-breakdown region, respectively, for different types of radiation influence: gamma-rays, protons, electrons, neutrons.

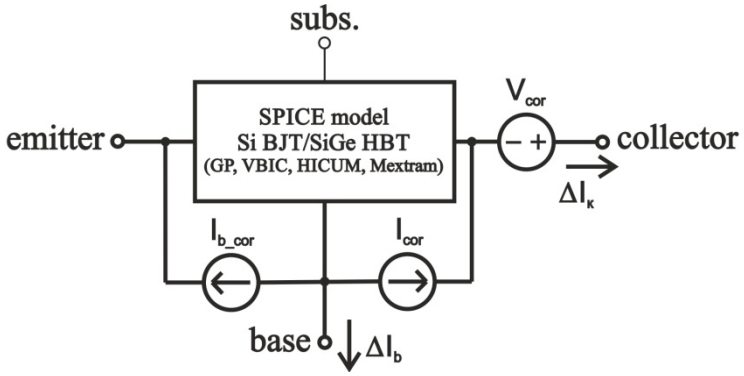


Figure 2. The compact SPICE-model of the bipolar transistor with additional components taking into account the effects of radiation influence

Circuit components of SPICE macromodels of Si BJT or SiGe HBT to account for the effects of gamma radiation are described by the following equation [10]:

- the current source $I_b(D)$:

$$I_b = I_{sd}\left(1+K_d\cdot D\right)\left(e^{\frac{U_{BE}}{n_{ed}}}-1\right)+I_{ss\max}\left(1-e^{-K_s\cdot D}\right)\left(e^{\frac{U_{BE}}{n_{es}}}-1\right) \quad (1)$$

where: I_{sd}, K_d, n_{ed}, I_{ssmax}, K_s, n_{es} – fitting coefficients; D – the absorbed dose; U_{be} – base-emitter voltage.

- the current source I_{cor} (D):

$$I_{cor}\left(D\right)=I_d\left(D\right)\left(e^{\frac{U_{CE}}{n_{es}}}\right); \quad (2) \qquad I_d\left(D\right)=v+g\left(e^{-h\cdot D}\right), \quad (3)$$

where: *v, g, h* – fitting coefficients; D – the absorbed dose; U_{ce} – collector-emitter voltage.

- the voltage source V_{cor} (D):

$$V_{cor}\left(D\right)=\sqrt{C\cdot D}\left(1-e^{\frac{U_{CE}\cdot B}{n_{es}}}\right), \quad (4)$$

where: B,C – fitting coefficients; D – the total dose; U_{ce} – collector-emitter voltage.

The developed SPICE-macromodel of Si BJT/SiGe HBT unlike other models [11-13], has more flexibility in describing the changes of the base current with reasonable accuracy. In addition, the changes of the saturation voltage and breakdown voltage on the output characteristics of bipolar transistors after gamma irradiation are taken into account.

Some examples demonstrate the application of the developed models for BJT and HBT characteristics simulation with account for radiation influence.

The following bipolar transistors were selected for simulation:

1. npn Si BJT with current gain β = 70, f_T = 1.9 GHz, f_{max} = 5.1 GHz;
2. SiGe HBT 8HP with min size 120 nm, β = 450, f_T = 200 GHz, f_{max} = 100 GHz,
3. SiGe HBT 9T with min size 120 nm, β = 1300, f_T = 350 GHz, f_{max} = 250 GHz.

Figs. – show comparison of simulated with the developed models and measured current gain for the mentioned transistors before and after exposure to different types of irradiation. It is seen that the experimental data and simulation results agree well with error of 10–15%.

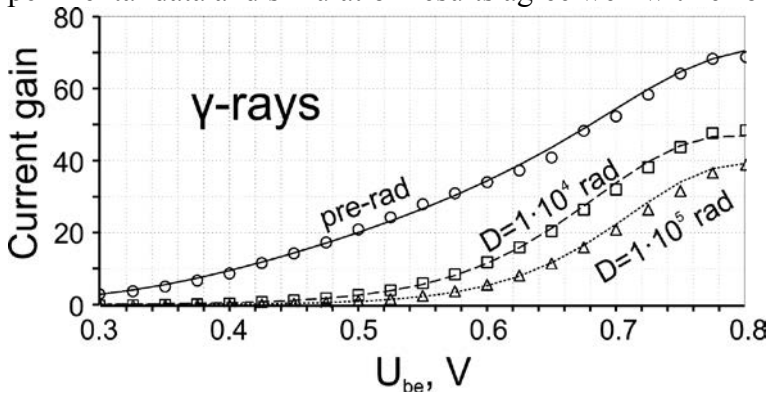


Figure 3. Comparison of simulated and measured current gain of Si BJT before and after exposure to γ-rays with total dose $1 \cdot 10^4$ and $1 \cdot 10^5$ rad

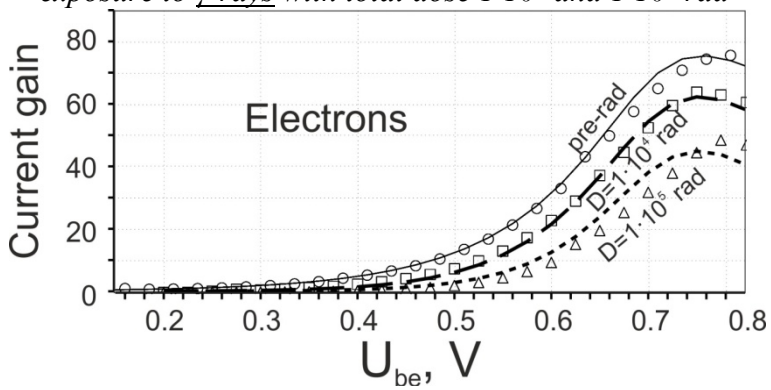


Figure 4. Comparison of simulated and measured current gain of Si BJT before and after exposure to electrons with total dose $1 \cdot 10^4$ and $1 \cdot 10^5$ rad

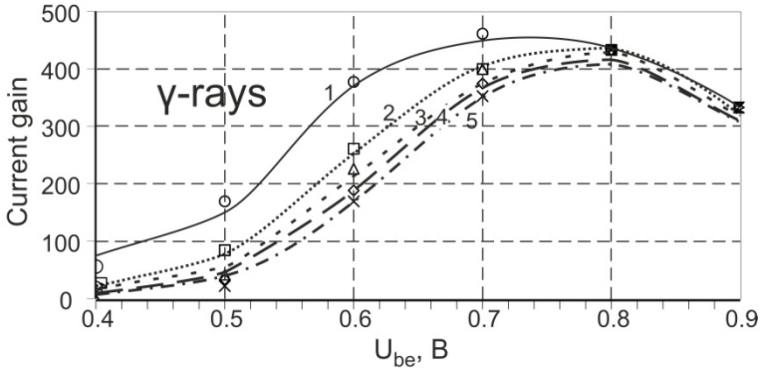


Figure 5. Comparison of simulated and measured current gain of SiGe HBT 8HP before (1) and after (2–5) exposure to γ-rays with different values of total dose: $6 \cdot 10^5$ rad (2), $1 \cdot 10^6$ rad (3), $3 \cdot 10^6$ rad (4), $6 \cdot 10^6$ rad (5)

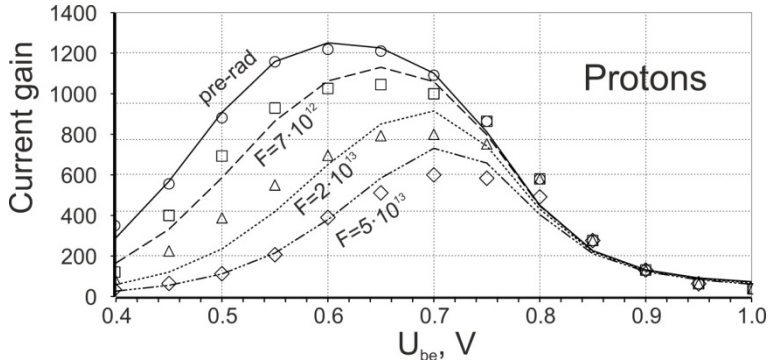
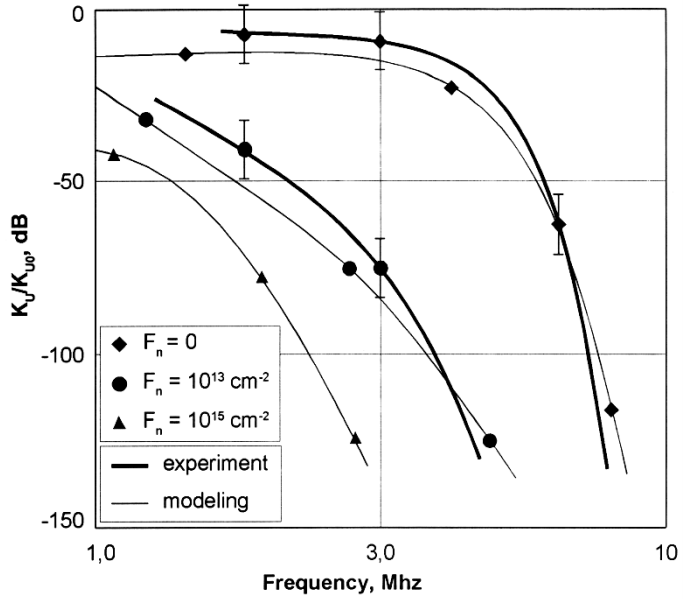
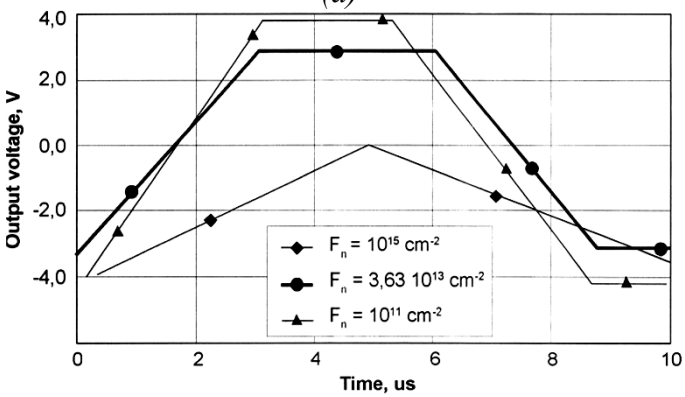


Figure 6. Comparison of simulated and measured current gain of SiGe HBT 9T before and after exposure to protons with fluence up to 5·1013 cm-2

Models application to circuit simulation. Figure 7 presents measured and simulated with the developed models OpAmp frequency response and transient response for different levels of neutron fluence. The OpAmp was realized using KB1451HN2-4 bipolar gate array. Our experience shows that the developed macromodels of Si BJT/SiGe HBT allow simulation of electrical characteristics of irradiated circuits with error less than 25%.



(a)



(b)

Figure 7. Measured and simulated OpAmp frequency response (a) and transient response (b) for different levels of neutron fluence

SOI/SOS MOSFET compact models with account for radiation influence and their application for circuit simulation

Complementary metal-oxide-semiconductor devices with a silicon-on-insulator/ sapphire structure (SOI/SOS CMOS) have strong prospects as components of radiation-hardened circuits used in aerospace systems, nuclear power electron equipment, military engineering, and other special applications. Two macromodels BSIMSOI-RAD [8, 10, 14, 15] and EKV-RAD [16, 17] were developed to describe submicron SOI/SOS CMOS transistors with proper consideration for effects arising from static and pulse radiation influence, single nuclear particles (single events).

The equivalent circuits of BSIMSOI-RAD and EKV-RAD macromodels are presented in Figure 8. The main transistor component M_{front} (BSIMSOI v3.2 or EKV v2.64 model with radiation-dependent parameters, see Figure 8,*a,c*) reflects the behavior of the front Si–SiO_2 interface. Other components are added to account for various radiation-induced static and dynamic leakage currents (see Figure 8,*d*).

The main part of the EKV-RAD macromodel – the standard EKV model [19] – was developed originally only for bulk MOSFET. We have modified and extended it for the case of MOSFETs with dielectric SOI/SOS substrates (see Figure 8,*b*).

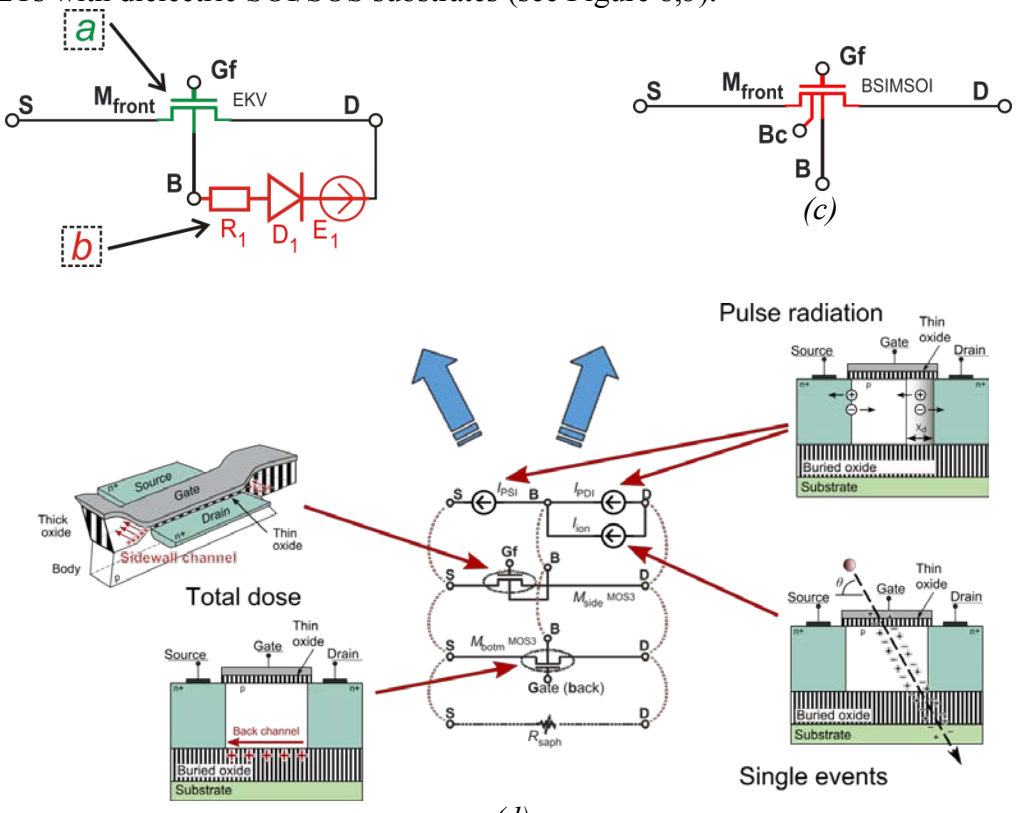


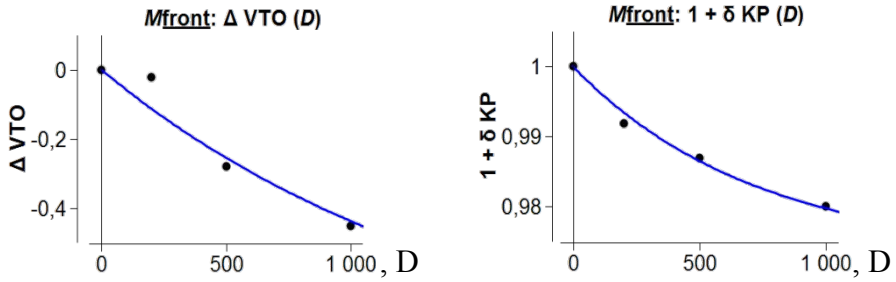
Figure 8. Equivalent circuits of the BSIMSOI-RAD and EKV-RAD macromodels for SOI/SOS MOSFET: a,c—core front MOSFET Mfront with radiation dependent parameters; b—subcircuit accounting for floating body effects in EKV-RAD; d—subcircuit accounting for static and dynamic leakage currents

Measurements show that model parameters for the main front gate MOSFET M_{front} and for other components become dependent on total dose after irradiation. Radiation dependent parameters of the core front MOSFET M_{front} and parasitic MOSFETs are threshold voltage with its factors (VTH0, VTO, etc.) transconductance and its factors (U0, UO, KP, E0, UA, etc.), and subthreshold slope factors (CIT, GAMMA, etc.). Absolute change in parameters that have a

dimension of voltage, and relative change in other parameters are given with expressions in the form of Eq. 5.

$$a_1 \cdot (1 - \exp[-a_2 \cdot D]). \quad (5)$$

In (5) a_1, a_2 are fitting factors related to ionization dose and electrical bias during irradiation. The typical radiation dose dependencies of these parameters are of the form given in Figure 9.



(a) (b)

Figure 9. The typical form of fitted model parameters dose dependency a) for voltages, b) for mobilities

To describe these dose dependencies, we use physical equations and approximations [18, 20]. Fitting factors in these expressions constitute the set of static radiation parameters of the macromodel.

Figure 10 presents an example of measured and simulated characteristics for SOI MOSFET with gate dimensions L/W = 0.13/8 μm. The error between measured and simulated I-V-characteristics is 10–15% in the entire voltage and dose range.

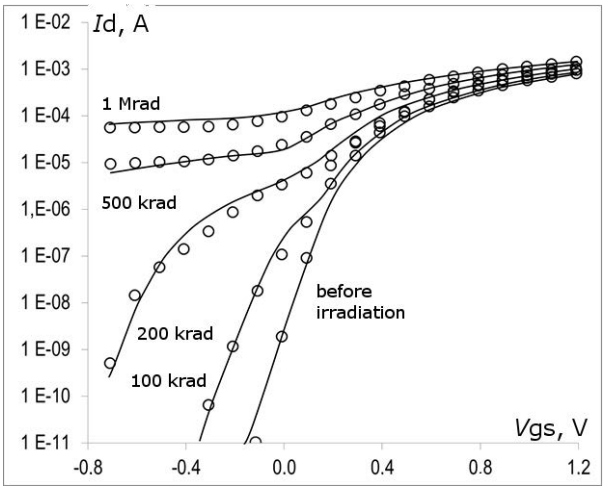
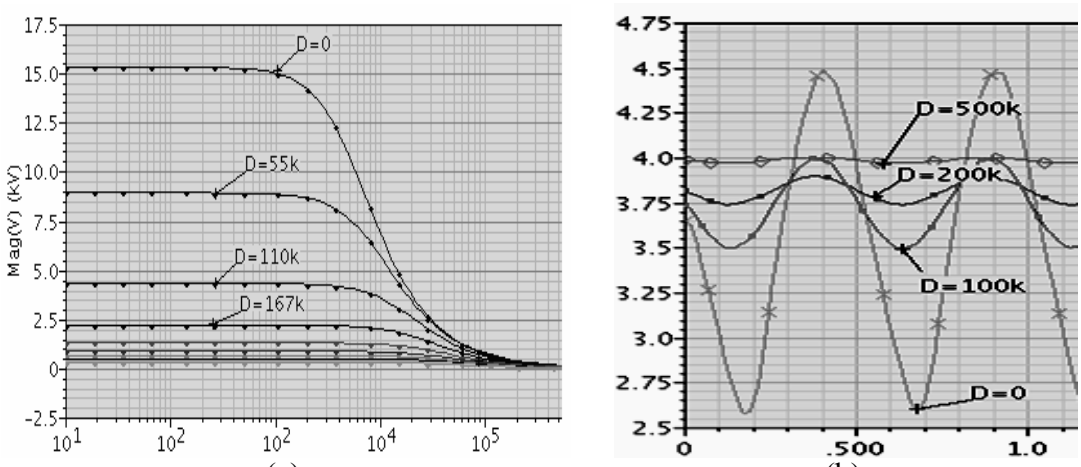


Figure 10 Measured (circles) vs. simulated (lines) characteristics for SOI MOSFET with gate dimensions L/W = 0.13/8 μm before and after exposure to γ-rays with dose up to 1 Mrad

Model application to circuit simulation. With the developed SOI/SOS MOSFET models that include dose-dependent radiation parameters, several analog IC fragments were simulated with account for total dose, including rail-to-rail operational amplifier whose gain stages are linear in the whole input voltage range. Frequency and transient responses were simulated with account for dose in the range 0÷1 Mrad (see Figure 11).



(a) (b)

Figure 11. Simulation of frequency (a) and transient response (b) for OpAmp before and after irradiation to dose in the range 0÷1 Mrad

The developed model was also applied to simulation of the memory cell circuit (see Figure 12) with account for a heavy ion impact at $t = 2.5$ μs on MPA transistor of the cell during storage time.

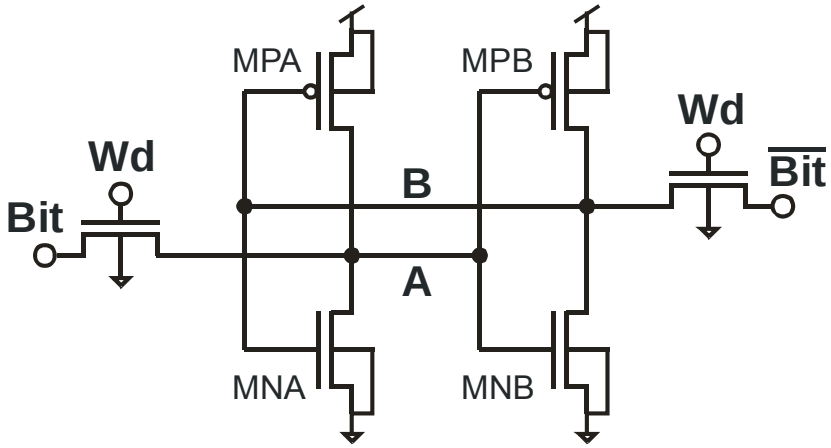


Figure 12. A 6-transistor CMOS memory cell for simulation of nuclear particle impact

Two different cases were simulated: 1) with impact of a ion with LET = 18 MeV·cm^{-2}/mg not leading to cell failure (Figure 13,*a,c*), and 2) with LET = 21 MeV·cm^{-2}/mg leading to cell failure (Figure 13,*b*). The failure of the cell depends on the amount of critical charge collected in the damaged transistor. The results of simulation correctly reflect the cell behaviour, which offers an opportunity to predict the cell fault-tolerance.

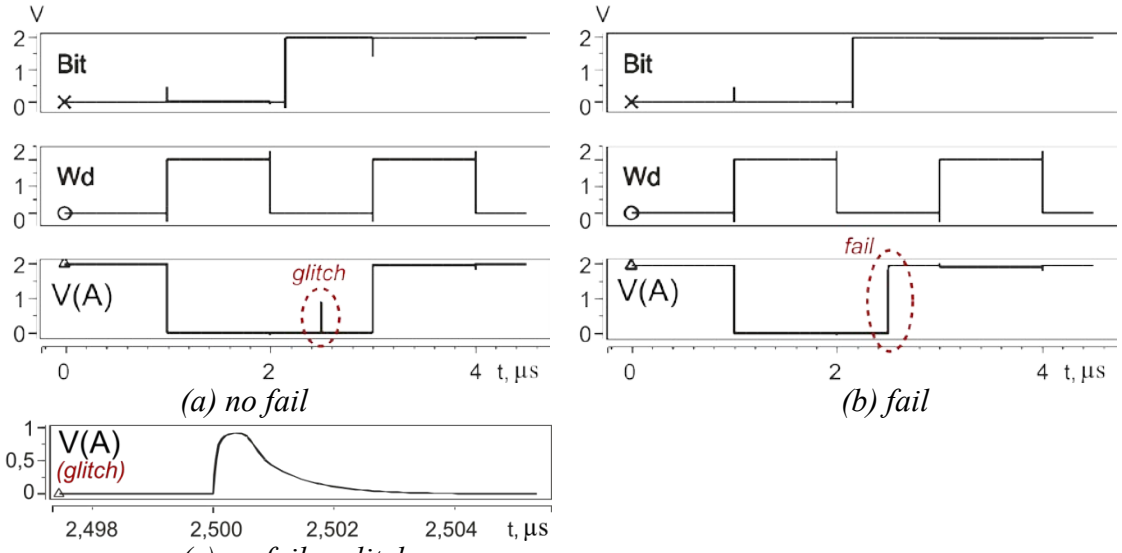


Figure 13. Simulated waveforms of a CMOS memory cell subjected to single nuclear particle impact on MPA transistor: cell operation succeeded (a), cell operation failed (b), output voltage V(A) glitch for the no-fail case (c)

Conclusion

The advanced SPICE device model library taking into account different types of irradiation (gamma-rays, protons, neutrons, electrons, heavy ions) was developed and became available to the community for CAD of electronic circuits and equipment working in extreme conditions. This device model library for RHCAD was included in commercial versions of SPICE-like software tools [1]–[4] and used in real projects of extremal electronics R&D [9], [15]–[17].

So the possibilities of commercial SPICE were expanded in new rapidly growing market segment of extreme environment electronics systems for aerospace, military, global communications, space-based remote imaging for climate and resource mapping, particle physics detection and measurement, health imaging, etc.

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DEVELOPMENT THE AUTOMATED GAS MIXTURE ANALYSIS SUBSYSTEM AND DESIGN THE ARCHITECTURE OF THE RING LASERS PRODUCTION MANAGEMENT SYSTEM

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There is considered the development of analysis subsystem of the gas mixture correspondence to technological requirements being an important stage of the ring laser

production management system creation. The problems and the results of designing a subsystem are analyzed. Proposed architecture of the unified production management system for the enterprise which is designing and manufacturing laser products is presented.

Key words: production control system, ring laser, gas mixture analysis

Introduction

In creation the projects on industrial enterprises automation the standard ISA 95 [1] is applied, which is one of the main international standards for factories automation. Its purpose is to propose the industrial enterprise's unified information model to be used in automation process.

Application of the standard reduces the risks, costs and errors associated with implementing systems of enterprise scale and manufacturing operations management systems, and makes it easy to combine and interact above systems.

ISA 95 standard consists of three parts, which generally describe the typical automatable functions of industrial enterprise and its information model.

In the context of the information model to be proposed by the standard the automatable functions of industrial enterprise are divided into two levels:

• the upper level includes automatable functions related to the company and its constituent departments;

• the lower level, which contains the functions related to the processes of collecting the metrological information and control by industrial equipment.

Thus, as it follows from the provisions of the standard ISA 95, when designing the enterprise's production management system there is appeared a problem of constructing a system architecture as a set of logically connected as the object information models, as the functions models, and above set forms the basis of the production process. CASE-tools are used for the construction of the proposed models. However, the use of CASE-tools becomes effective only if the mathematical models describing the main objects and functions involved in the enterprise's production management system have been developed [1].

The final stage of construction of the production management system is the association of closely interacting subsystems with their local operating goals and objectives in a unified system to make possible not only automating the production process, but also bringing it to a higher level.

Production of the ring lasers is a science-based manufacturing process that uses modern technologies. Its efficiency and stability depend on arrangement of the information system supporting the process at all stages.

Current problems are as follows:

• traditionally arranged individual production facilities not to be interconnected with a unified information base and production management system;

• insufficient automation in production facilities, including manual entry of identification and metrological data;

• high scientific background of manufacturing procedures, that requires deep study of specific physical processes occurring in ring lasers at each stage of production, and taking into account this specificity in the development of data processing algorithms (for example, accurate knowledge of the maximum allowable time of experimental data evaluation);

• the need to combine in the analysis and management system two options: the mode providing the minimum time in estimation of product quality to achieve high efficiency in mass production and the mode corresponding to the implementation of accurate, not time-limited research in scientific experiments.

This paper describes the design phase of the ring lasers production management system related to one of the most important quality control stages – determination of the gas

components ratio in working gas mixture that permits to evaluate the quality of the cavity and to predict its shelf life.

The purpose of this work is the development of subsystem with improvement the existing method of analysis of gas composition correspondence to technological requirements and exception the manual data processing.

Implementation of this subsystem will increase the speed of the analysis operation and as a result the entire production process speed as a whole, will exclude possible computational errors caused by human factor.

One of the requirements to the subsystem is the flexibility in producing different tests scripts. This will give the opportunity to use it most efficiently with considering the requirements of production to testing and ensuring a sufficiently high degree of subsystem versatility.

In this regard, the task of development of the automated analysis subsystem of the gas mixture composition correspondence to technological requirements is very actual. The concept of building this subsystem is proposed in this paper.

The essence of the analysis method of gas composition correspondence to technological requirements

Researches were carried out for compact monoblock resonator of helium-neon laser, which is showed in Fig. 1.

Fig.1. The ring laser

Helium-neon mixture is a medium which purity determines the accuracy characteristics of the device and its life time.

Manufacturing of devices from optical materials is technically difficult task, which does not exclude the possibility of the micro-defects appearance.

For manufacturing helium-neon lasers cavities there are selected the materials with low thermal expansion coefficient (TEC) and high hardness. When drilling channels in the cavity and the processing of parts to give them the desired shape the micro-defects are occurring on the channel walls and on the parts surface, the subsurface damaged layer is appearing. In that layer the gases are adsorbed which came into the cavity while manufacturing, and then during operation that gases are being emitted into the cavity internal volume.

Mirrors and other parts are connected to the cavity by optical contact. Due to microdefects the connections do not provide hermetically sealing of the cavity, so there is a leakage of the working gases (primarily He) from the interior of the cavity and the penetration of impurity gases from outside.

In addition, the reason for changing the gas composition in the cavity may be the adsorption properties of the aluminum cathode, which has a damaged layer with a lot of defects and pores.

Thus, the composition of the active mixture can vary during operation and storage, that can lead to malfunction of the device and ultimately to its failure.

One of the exploitation requirements of this device is shelf life for 15 years.

A prerequisite for this is insurance that during storage the gas mixture in the cavity will not change as for the main working gases He and Ne, and for impurity content.

Leakage flow for the device is determined by the relation [2]:

$$Q = \frac{\Delta PV}{T}. \quad (1)$$

Research proved to ensure shelf life for 15 years the admissible flow leakage must not exceed $2.7 \cdot 10^{-11}$ Pa·m^3 / s.

The equipment to be currently used for vacuum processing cavities is not able to measure flow leakage less than $6.7 \cdot 10^{-13}$ Pa·m^3 / s, and therefore the procedure was developed for predicting cavity storage on leakage by spectral analysis [2].

This procedure allows to predict with high accuracy the time during which the gas mixture of the optical cavity will permit him to maintain the required exploitation performances.

Since the main reason in the considered cavities for deviations on impurity gases is the presence of nitrogen impurities, the experimental study was carried out for that gas.

In cavity selected for the experiment we measured nitrogen concentration immediately after the ignition of the discharge.

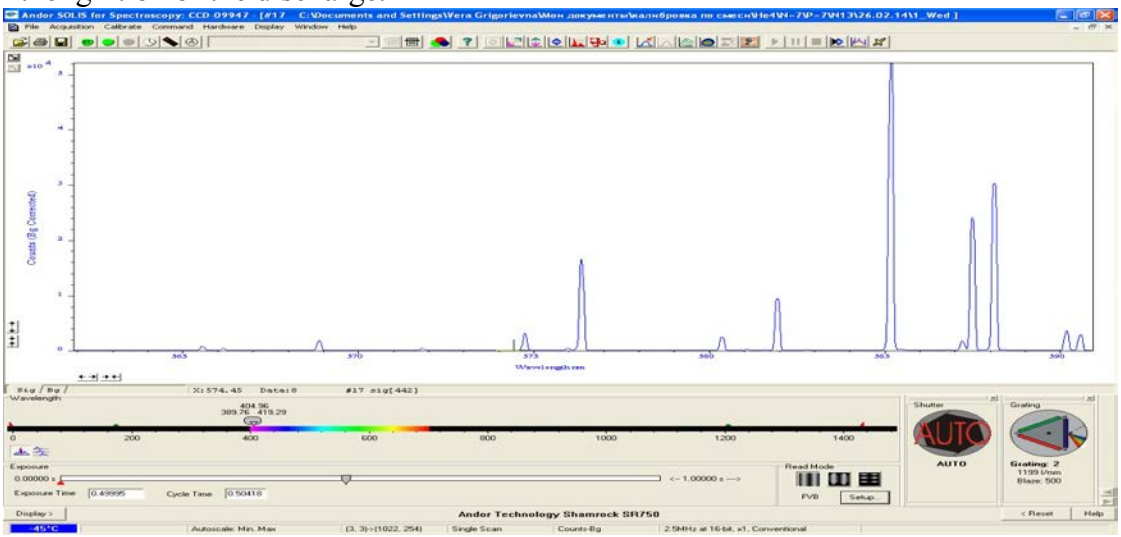

Fig. 2. The spectrum of the gas composition

Procedure of determining the composition of the working gas mixture for He-Ne ring lasers which uses emission spectral analysis have been proposed in [2]. It based on the measurement of the intensities of the helium lines 5016Å and 5876Å and neon line 5853Å in the spectrum of discharge gap spontaneous emission, calculation the ratio of the intensities $\alpha = I_{5016}/I_{5876}$ and $\beta = I_{5016}/I_{5853}$, determination the pressure P and the ratio of the partial pressures of helium and neon $N = \frac{P_{He}}{P_{Ne}}$ on the calibrating dependences P = F (α) and N = = F (β, P).

Extrapolation of the experimental dependence of P = F (α) allows to derive the following formula to determine the pressure of the mixture:

$$P = 10^{\left(\frac{1}{0,9314}\right) \cdot \lg\left(\frac{0,75}{\alpha}\right)} \quad (2)$$

Calibrating dependences N = F (β, P) are a family of linear functions β = kN + C, intersecting at a point M (N = 0, β = 0.028), the slope of which k depends on the pressure of the mixture.

Plotting the dependences of k = F (P) and extrapolating it, we obtain the following formula for the calculation N:

$$N = \frac{(\beta - 0.028) \cdot P^{2.0133}}{0.198}. \quad (3)$$

The main goal of tests is to determine the leakage flow, which allows to predict the possible time of the tested device storage.

For this purpose, the following measurements and calculations are to be made:

• calculating the initial value N_{r0}

$$N_{r0} = \frac{I_N - I_{Nnoise}}{I_{He}}; \quad (4)$$

• repeating the measurements and determining N_{rel1}.

If in the second measurement relative level of nitrogen N_2^+ at wavelength 3914Å (N_{r1}) appears more than previously measured (N_{r0}) by an amount $\Delta N_r \geq 0.013$, where $\Delta N_r = N_{r1} - N_{r0}$, the following steps are to be performed:

1) estimate the value of flow leakage as follow:
   - determine ΔP_N on the calibrating dependence $\lg\Delta P_N = F(\lg\Delta N_r)$;
   - calculate the leakage flow by the formula:

$$Q = \frac{\Delta P_N \cdot V}{t} \left(\frac{Pa \cdot m3}{s}\right), \quad (5)$$

where V – volume of the cavity (m^3);

t – time between measurements;

ΔP_N – change of the nitrogen partial pressure, Pa.

2) evaluate the device predicted life time on leakage of nitrogen:

$$T = \frac{P_{Nкр} \cdot V_{рез}}{Q}, \quad (6)$$

where $(P_{Nkr} \cdot V_{rez}) = 1.33 \cdot 10^{-5} Pa \cdot m^3$;

Q – flow leakage.

To calculate the leakage flow and the device predicted shelf time on leakage of nitrogen the computer program "Primes" may be used. Data are being entered manually in this program, that noticeably slows down the process of testing and can lead to significant errors.

Improvement the gas mixture analysis subsystem and design the architecture of the ring lasers production management system

Previously described procedure is proved to have computational complexity. Now at the enterprise there are separate software tools, allowing to calculate the required parameters, but they are not integrated into the system. Because of this, the present method of analysis contains various operations with data performed by a man. Aside from the obvious influence the human factor on the process of testing the disadvantages described above also significantly slow the process. Moreover, existing software does not perform automatically a series of measurements and currently they are made by man. This causes difficulties in projecting of automated control system for ring lasers. Besides, testing time should be reduced to save the cavity being tested.

In this paper, the following investigations were carried out:

• research possibilities of upgrade the current software for gas composition analysis subsystem to create a unified control system for ring lasers;

• expansion software capability to enable experimental studies of gas mixture changing processes in the cavity, including an analysis of the most frequently occurred in cavities impurity gases such as oxygen, nitrogen, carbon monoxide and carbon dioxide, and hydrogen.

Considered in this paper the automated gas mixture analysis subsystem is related to the lower level of the standard ISA 95 and is an important part of ring lasers production management system.

Existing model of architecture of automated system corresponding to the technological process is presented in Fig. 3. Its occurrence is associated with the beginning of the period of transition to computer technology, when all laboratories have structured their own data and

created their databases, which have allowed them to work with the information with greater efficiency.

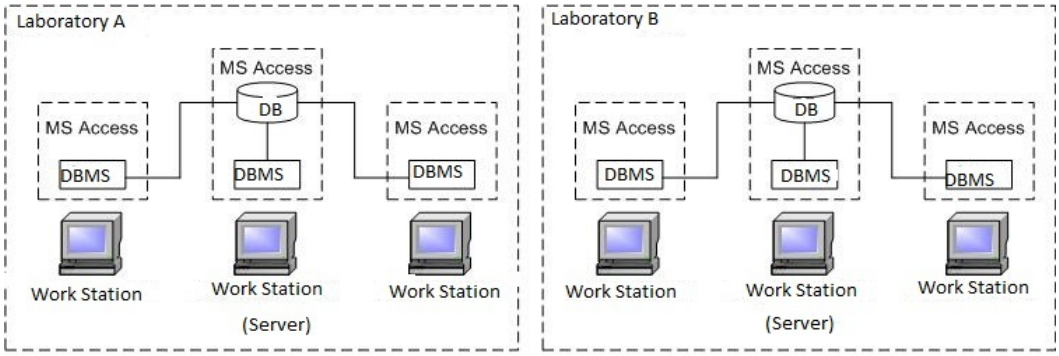

Fig. 3. Existing model of production automation system architecture

It is a collection of independent databases with information exchange between them through external drives and paper records. With this organization the data follow the same route as the objects to which they relate. Data flow model fully repeats the existing technological process and rigidly attached to him. However, considering that information is being entered at the user's workplaces and stored in local DB with different logic structure the part of data is duplicated. As a result, any information changes require updating all the prototypes in the back direction of the information transmission route until the source. So, the existing informational model of the technological process needs in improvement [3].

To enable future upgrades of DB most productive, the following conditions must be observed:

1) DB structure at all stages of development must be changed by the same predetermined rules;

2) actions not required of human participation must be entered into the automation system;

3) DB model adequacy to subject area must be provided.

Obviously, modernization of the existing information system of the technological process at the enterprise needs qualitatively new informational model. For that a set of universal solutions can be formulated as follow:

1) automating the process of data exchange;

2) coordination of statistical research;

3) tracking of the status of all database's elements at all technological stages;

4) introduction "browser" technology.

Operation with the data in the system with a single server will be implemented under the scheme: *User - Browser - Web- server - DBMS - DB*.

As a result of research the new informational model was developed. All information in this model is in a common database, all data are being sent over the network, and "browser-based" technology is used.

Fig. 4 shows the proposed new informational model on the example of two virtual laboratories A and B.

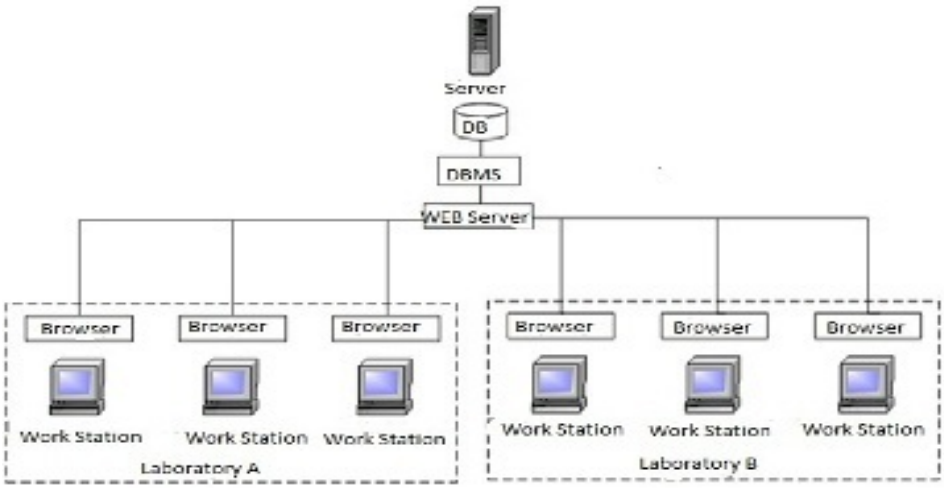

Fig. 4. New model of production automation system architecture

The transition from a model of local information system architecture realizing the corresponding technological operations to a model of system architecture with a single server (common database serving the total technological process) suggests the developer the following requirements to the projected model of the database:

- simplicity of using,
- portability,
- scalability.

Thus, the proposed concept of system architecture model with a single server will eliminate the disadvantages of the existing information model and will initiate the creating a unified ring lasers production control system. This will be able only with high automation of each manufacturing stage, possibility of including it in the common information system. That is the reason why the development of the automated analysis subsystem of the gas mixture composition correspondence to technological requirements is an actual problem.

Conclusion

Proposed in this article approach of designing subsystem of the gas mixture composition correspondence to technological requirements being a part of the ring lasers production management system is effective from technical and economical estimations.

However, analysis of the features of the ring lasers designing and technological cycle showed that manufacturing of high-tech products such as lasers in accordance with the requirements of ISO 9001:2000, is a complicated task and its solution is impossible without creating a unified information space at the enterprise. Forming of this information space is impossible without achieving a high degree of automation at the each stage of production including quality control. Therefore, development of a subsystem of the gas mixture composition correspondence to technological requirements is an important step towards the creation of integrated management system for ring lasers production.

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PROCESS OF DATA TRANSMISSION IN THE ONBOARD CONTROL SYSTEM

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The analysis of the data bus used in the onboard control system. The basic characteristics and features of protocols avionics data bus and given their comparative characteristics.

Key-Words: aircraft, data bus standards, aircraft data bus, ARINC 429, ARINC 629, MILSTD 1553, MIL-STD 1773, IEEE 1394. digital data transmission,

Aircraft design today involves far more than thrust and aerodynamic surfaces. Modern aircraft must support high volumes of data exchange among communications systems, weapons systems, flight-critical systems, and more. Whether they're jets like the F-35 Joint Strike Fighter or unmanned aerial vehicles (UAVs,) successful operation of today's military aircraft requires robust, high-speed data buses.

In earlier analogue avionic systems the number of cables used to transfer information between the various system components was considerable. With these systems, at least one pair of wires has been required for each signal and so a typical installation requires several pairs of wires. With the equivalent digital systems, all the analogue signals are converted into their equivalent and are assigned unique address labels to ensure there are no conflicts. These signals are then transmitted down a single pair of wires, which makes up a data bus. Aircraft data bus systems allow a wide variety of avionics equipment to communicate with one another and exchange data. The type of language used on an aircraft data bus is known as the protocol.

Bus systems provide an efficient means of exchanging data between the diverse avionic systems found in a modern aircraft. All buses consists of two parts – an address bus and a data bus. The data bus transfers actual data whereas the address bus transfers information about where the data should go. On an aircraft bus, the two parts are incorporated within a single data word. A bus can be either serial or parallel. A serial bus requires less wiring, but is working slower. A parallel bus required one wire for each bit within the data word, but the transmission is much faster. Aircraft bus systems use serial data transfer because it minimizes the size and weight of aircraft cabling. With such a large number of avionic systems, a modern aircraft requires a considerable amount of cabling. Aircraft cabling amounts to a significant proportion of the unladen weight of an aircraft and so minimizing the amount of cabling and wiring present is an important consideration in the design of modern aircraft, both civil and military. A data bus also classified. A bus that can transmit in just one direction it is termed simplex. If it can transmit in both directions, but not at the same time it is termed half duplex. Where a data bus can transmit in both directions at the same time, it is termed full duplex.[3]

As systems on Aircraft became progressively more digital in nature, it became apparent to avionic designers that a multiplexed bus system was required to enable all subsystems to be connected by only one set of wires.[4]

Multiplexing has several advantages:

• Weight reduction
• Easy
• Standardization
• Flexibility

Multiplexing simplifies the transfer of information along the data flow. This allows the transmission of multiple signal sources over a single communication system.

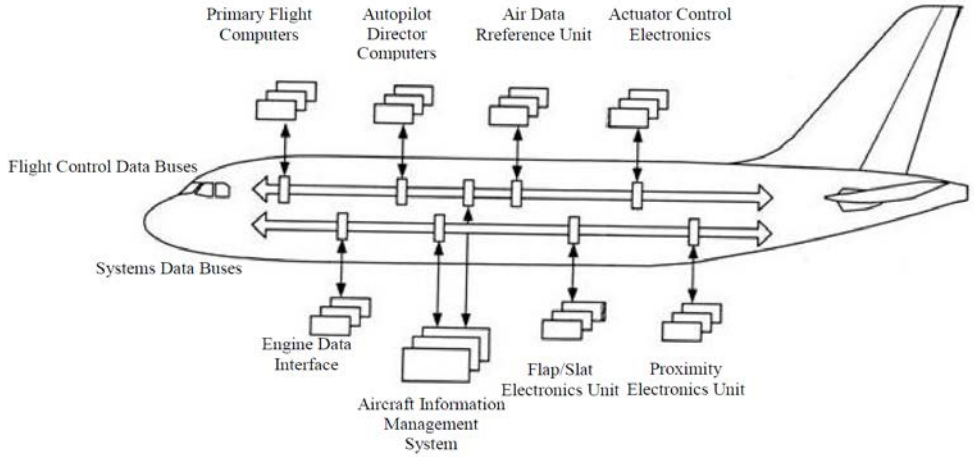

Fig. 1 – Multiple bus systems implemented on modern passenger aircraft

Data transmission is the conveyance of information from source to destination Integrated digital avionics data bus allows data multiplexing, transmission/reception and communication of on-board avionics data in modular avionics architecture. Since avionic systems place great emphasis on the reliable and timely transfer of information, specific data bus protocols for avionic systems have been designed: ARINC 429, ARINC 629, MIL-STD 1553, MIL-STD 1773, and can also be used IEEE 1394.[2] Further considered their main features and a comparative table.

ARINC 429

ARINC 429 is a two-wire data bus . Connecting wires - twisted pair. The word size is 32 bits , and most messages consists of a single data word . The specification defines the electrical characteristics, specifications and data exchange protocols . ARINC 429 uses a unidirectional data bus standard (transmission and reception lines are physically separated) . Messages are transmitted at one of three rates: 12.5, 50 or 100 kbit / s. The transmitter is always active, it transmits either 32- bit data words or issue an "empty" level . Bus is allowed no more than 20 receivers , and not more than one transmitter.

Each plane can contain many different systems, such as flight control system , inertial navigation system , air signals system , altimeter , Radio, sensors and GPS. For each type of equipment defined set of standard parameters are the same for all makes and models . For example, any inertial navigation system is the pressure altitude of the aircraft as a mark of 203. This allows a certain degree to ensure interchangeability of parts , since all inertial navigation systems behave , for the most part , in the same manner . Nevertheless, the number of labels is limited, thus , the label 203 may have a completely different matter if the sensor is sent GPS. However, the various aircraft systems typically use a label regardless of the source . Furthermore, as is usually the case with any specification , each manufacturer has slight differences from the formal specification , for example, added additional information not described in the specification are not given some data , the recommended specification , etc.[1,2]

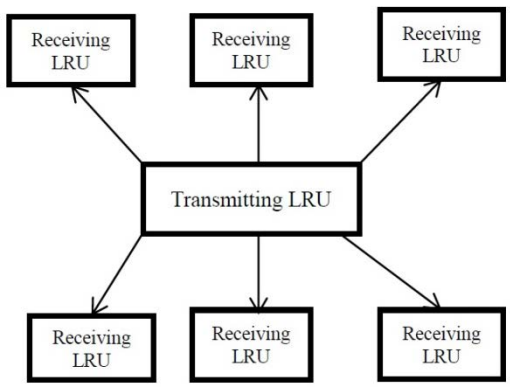

Fig.2 – Star Topology

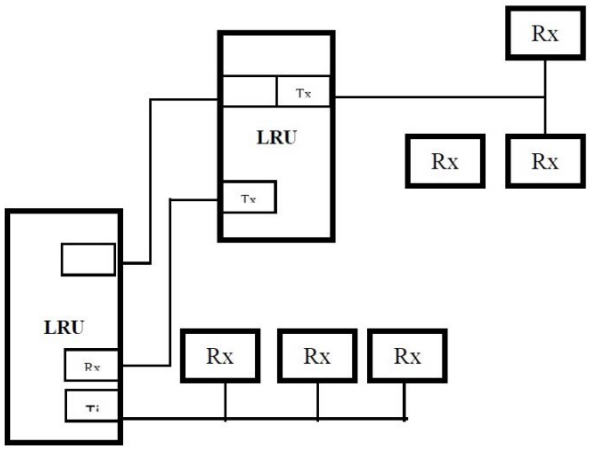

Fig. 3 – Bus-drop Topology

ARINC 629

ARINC 629 is an improved version of ARINC 429.

ARINC 629 major improvements compared with the ARINC 429:

• increased the number of the bus (from 20 to 120);

• become bidirectional bus (ARINC 429 bus allowed only transfer from one subscriber to a few);

• increased bus bandwidth (c 100 kbit / s to 2 Mbit / s).

The need for high-bandwidth airborne avionics data links that are lightweight, immune to electromagnetic interference and highly reliable are always felt. So, the next stage of development is optical fiber data communication. Modern digital avionics systems require a system capable of transporting microwave and millimeter-wave RF signals that carry digital data on board an aircraft. The high bandwidth-to-weight ratio, performance and routing flexibility offered by the combination of single mode optical fiber and wavelength division multiplexing (WDM) are among the prime attractions justifying the optical network approach to on-board avionics communications systems.

The ARINC 629 is a new standard for aviation industry for the transformation of digital data between avionics system elements. The ARINC 629 civil aircraft data bus standard has been developed as a successor to ARINC 429. It's used in the MAC layer protocol. By the concept of bus cycle, this protocol manages periodic and aperiodic traffic exchanges. Its unique feature is that there is no need for a bus controller and bus access is determined by each terminal.

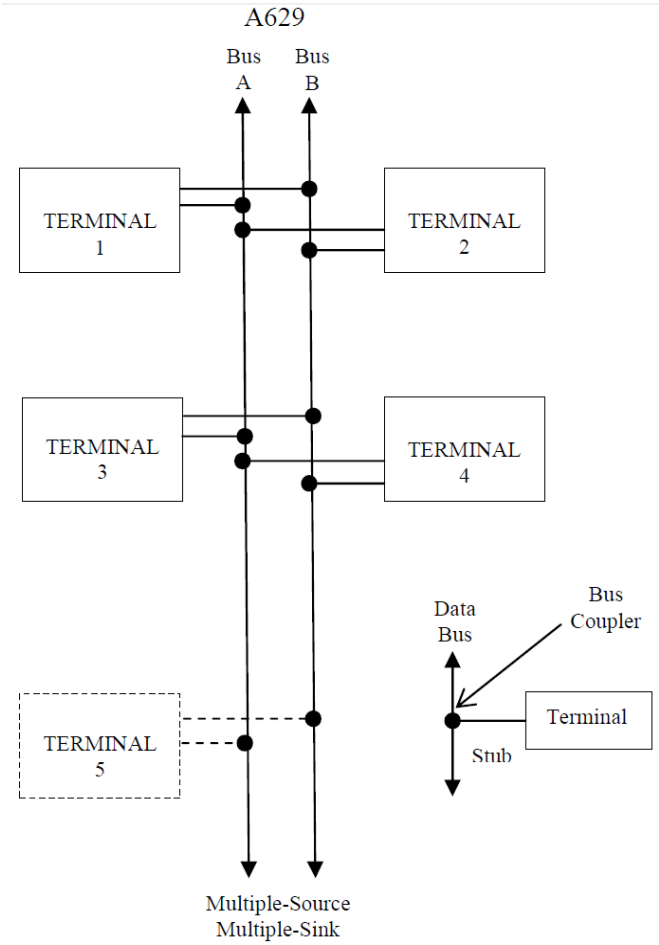

Fig.4 – ARINC 629 Data Bus Topology [3]

The bus access control is distributed among all the participating terminals.)

ARINC 629 was implemented on Boeing 777. There exist two implementations of ARINC 629:

- Combined Mode Protocol (CP);
- Basic Mode Protocol (BP).[4]

ARINC 629 can be implemented in three media: wire, inductive or voltage coupling and optical fiber. Optical implementation offers the same alternative bus configuration as of DOD-STD-1773.[2]

MIL-STD-1553

MIL-STD-1553 is a reliable, deterministic data bus for connection of sensors and controllers for real-time computing modules critical systems. Over the past 20 years it has become the most widely used military highway systems, including aircraft, ground vehicles and ships. Her long life due to the following factors:

- linear architecture of local networks;
- redundancy options;
- support both simple and intelligent nodes;
- high electrical protection;
- wide availability of components;
- guaranteed determinism in real time.

Feature of the interface is dual redundant information transmission line, half-duplex protocol "command-response" and up to 31 remote subscriber (terminal). Each line is controlled by its own controller channel.

First published in the U.S. Air Force as a standard in 1973, applied to the F-16 fighter. Adopted as a standard NATO - STANAG 3838 AVS. In modern aircraft is replaced the standard IEEE 1394b.

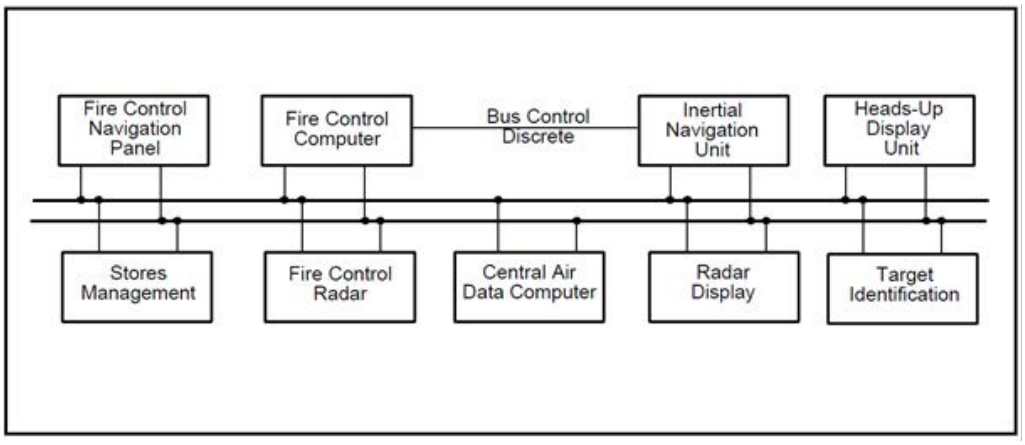

Fig. 5 – Typical Bus Architecture

A 1553 linear topology is ideal for connecting distributed devices on board the aircraft or vehicle. Compared with the point to point connection bus characterized by shorter length of connecting cables, which leads to a reduction in the overall vehicle weight and space savings. In addition, ease of connecting and disconnecting from the network nodes for easy maintenance and repairs.

By doubling the bus protocol 1553 provides fault tolerance and automatic switching on additional channels for transparent accountable system software.

Supports both simple and intelligent nodes. By bus 1553 can connect dumb devices that provide interaction of sensors and actuators to the system. However, it is ideal for connecting intelligent computing modules distributed intelligent slaves.

Despite the all the attractive side of MIL-STD-1553, which contributed to its popularity, the use of tires in the most demanding military systems is hindered by a low-speed serial data transmission of 1 Mbit/s. Although this rate is sufficient to perform the traditional functions (such as control of the landing gear and military equipment), it did not have enough to transfer video, audio and voice data between distributed intelligent nodes of modern aviation and electronic transport systems.

GOST 26765.52-87, GOST R 52070-2003, MKIO – Russian equivalent of the American military standard MIL-STD-1553 (MIL-STD-1553B). [5]

MIL-STD-1773

MIL-STD-1773 - the second version of the standard MIL-STD-1553, in which as an information transmission channel used optical fiber having reduced weight and better performance on electromagnetic compatibility.

The standard is the equivalent of MIL-STD 1553 having the same word structure and length and bus protocol. The optical power levels, wavelengths and means of distributing optical power in any specific implementation must be contained in a specification which refers this standard.

Coding format data word are identical and MIL-STD-1553, except that the pulses are defined as transitions between 0 (off) to 1 (inclusive), and not between the + and - voltage transitions, since light can't be negative. The standard is applied to the cable only, the bus operates at the same rate as it was by using a wire. In addition, the data error rate requirements remain unchanged.[5]

In modern aircraft, be replaced by the standard IEEE 1394b.

IEEE 1394

IEEE 1394 (FireWire, i-Link) - high-speed serial bus designed for the exchange of digital information between computers and other electronic devices.

IEEE 1394 devices are organized in a three-tier scheme - Transaction, Link and Physical, corresponding to the three lower levels of the OSI model.

The logical high-speed interfaces defined by the IEEE 1394b standard can link together multiple devices to minimize wiring and, hence, weight, always a factor in avionic systems. IEEE-1394b-compliant data buses like FireWire provide a range of topology choices, including tree architectures, daisy chains, and even loops to support redundancy and hot swaps. The standard has a track record of success, supporting the vehicle management system (VMS) in the F-35, for example, which facilitates communications among more than 70 separate devices that deliver critical operational data on engine and flight controls, weapons systems, mission details, and communications.

When it came time for the X-47B Unmanned Combat Air System Demonstration (UCAS-D), a 1394b bus was the natural choice. The X-47B required a network backbone to provide guaranteed quality of service with predictable latencies in real-time control applications, which it achieves with the help of SAE-defined AS5643, the military version of the 1394b standard.

When coupled with AS5643's fixed-frame-rate synchronization, the 1394b bus provides predictable latencies that allow to the house all flight-control algorithms and utilities in a highly centralized structure, while interfacing easily with legacy buses such as those compliant with MIL-STD-1553. The architecture also makes use of independent controllers for applications that require dedicated, high-bandwidth control loops.[6]

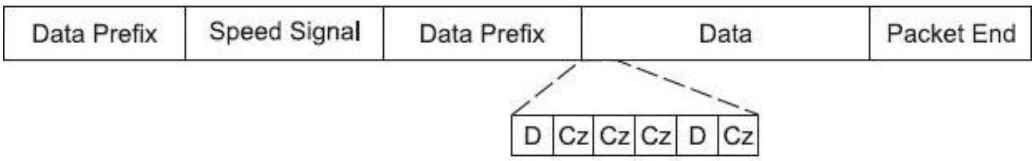

Fig.6 - Packet Transmission 1394b [8]

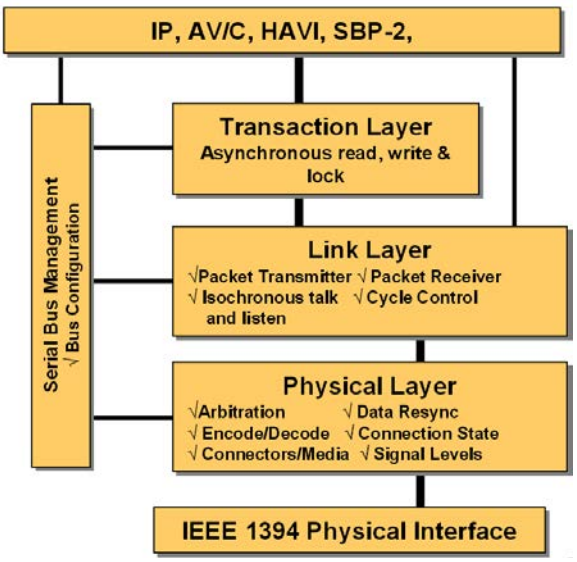

Fig.7 – Protocol Architecture IEEE 1394 [7]

The success of 1394b-compliant interfaces in this high-profile, mission-critical program reflects the bandwidth, distance, and quality of service features enabled by the standard. The guaranteed quality of service and predictable latencies provided by the standard

make the data bus well-suited to military and aerospace applications in general, making it likely that we will see additional implementations in the future.

KEY DIFFERENCES BETWEEN ARINC 426, ARINC 629, 1553, 1773 AND IEEE 1394

Features	**ARINC 429**	**ARINC 629**	**1553**	**1773**	**IEEE 1394b**
Year of introduction	1977	1995	1973	1979	2002
Bus Architecture	Simplex point to point	Time division multiplex	Time division multiplex	Time division multiplex	point to point
Ports	2	1st standard, 2nd optional	1st standard, 2nd optional	1st standard, 2nd optional	4
Wires	Shielded twisted pair of wires	Unshielded twisted pair of wires	Twisted shielded pair in a protective shell	optical fiber	optical fiber, plastic - for cable lengths up to 50 meters, and glass - for cable lengths up to 100 meters
Encoding	Bipolar, return to zero	Bipolar, doublets Manchester	Manchester II	Manchester II	NRZ coding method
Data Rate	12.5 or 100 kbit/s	2 Mbps	1 Mbps	1 Mbps	800 Mbps and 1600 Mbps
Bus frequency	12.0, 12.5, 14.5 or 100 kHz	2 MHz	1 MHz	1 MHz	24,5760 MHz
Word Update	1 ms to 10 sec, (selectable)	1 ms to 10 sec, update rate displayed instantaneous, min or max value	4 microseconds - between messages generated by the bus controller from 4 to 12 microseconds - pause before sending the message response words	4 microseconds - between messages generated by the bus controller from 4 to 12 microseconds - pause before sending the message response words	After sending to 0.75 ms confirmation expected. Interval of at least 1 ms separates packets.
Divination of areas	Three areas : logic 0,logic 1 and Null	Four areas: Periodic traffic ,Urgent	Logic 1 (+pulse); Logic 0	Logical 1 (inclusive); Logic 0 (off)	Asynchronous and isochronous

		aperiodic traffic ,Non Urgent aperiodic traffic (backlog, new)	(-Pulse)		
Bit wise Comparison					
Data Bit	11-29	4-19	4-19	4-19	0-31
Bits 1 to 8	Bits (1-8) for label	First three bits are related to word time synchronization	1-3 Clock signal	1-3 clock signal	4-bit transaction code defines the packet format and the transaction to be performed such actions as, write a query to write the answer, read request, and read the answer. Transaction code field also indicates whether asynchronous or isochronous action.
Parity Bit	Bit no. 32 is parity bit	Bit no. 20 is parity bit	Bit no. 20 is parity bit	Bit no. 20 is parity bit	Bit no. 32 is CRC
Electrical characteristics	6,5-13V		18-27 V		1,5A 8-40 V

This paper gives a comparative overview of the five communication protocols used in avionics data bus. From an assessment of their key features it can be concluded that ARINC 429 is an easy-to-implement, inexpensive protocol whose reliability has been adequate for most applications in the early ages. But, for high speed data transfer, protocols could be based on redundancy, and is used for data transmission fiber avionics become more profitable for commercial aviation applications.

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DEVELOPMENT OF ALGORITHM FORIMPLEMENTATION AND MANAGEMENTOF HAZARD ANALYSIS AND CRITICAL CONTROL POINTS

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The article is concerned with the system of hazard analysis and critical control points, which currently is the basic model of quality management and food safety. An algorithm for implementing the HACCP system is developed.

Keywords: system of hazard analysis and critical control points (HACCP), security, critical points, risk factors, quality management, algorithm.

Currently, quality becomes the main criterion for competitiveness. Mass media, private entrepreneurs and state control structures place high emphasis on the problems of the manufacturer guarantee of the quality and safety of finished goods and on methodologies that allow to systematize and standardize work in this area. This information becomes more accessible and widely distributed, thereby increasing consumer culture and consumer interest in the activities of enterprises in the field of quality. According to the materials of social studies, more than 70% of buyers prefer the quality of the product to its price and often purchase products of large or well-known manufacturers, using their own experience (second purchase) or the recommendations of friends.

Quality is not some abstract concept and depends not only on the willingness of the consumer; it is composed of a set of quality indicators, the stability of which is the goal of the manufacturer. Most businesses know that they need to work constantly in order to ensure the output of high quality products. On the question of how to achieve this, there is quite a simple answer, backed by experience in implementing quality management systems at many enterprises in developed countries.

The Quality Management System occupies an important place in the management of the organization along with financial management, production management, supply management, personnel management, etc. In foreign practice, a quality management system certificate issued by an authoritative accredited certification body has long been a sort of the market permit and guarantee of high quality and safety of the finished product, as it is food safety that is one of the most important global issues today [1].

Several types of quality assurance systems (QA- system) and standards that can be used in the form of recommendations for the development of the company's quality system, allowing to meet the specified quality requirements, have been developed for the food industry [3].

QA- systems most commonly used in the food industry are codes of good practices. For example, Good Manufacturing Practice (GMP), Good Hygienic Practice (GHP), etc. Also HACCP system (Hazard Analysis and Critical Control points) and combined systems are applied.

When developing and manufacturing food products, special attention is paid to quality and safety. Security level is estimated in finished products and considered at the initial stage of selection of raw materials and auxiliary supplies (input control). However, most of the properties that characterize the quality of the finished product (microbiological, physico-chemical, organoleptic, etc.) are formed as a result of the technological process. This is the most important criterion for determining the quality of the product, which is directed to minimizing the possibility of dangerous situations that adversely affect quality.

According to the World Health Organization (WHO), three or four million cases of various intestinal infectious diseases and severe poisoning caused by substandard food are registered each year.

Number of prerequisites leading to the growth of poisoning tends to increase. This is due to environmental degradation, the use of new agricultural commodities (e.g. genetically modified), a wide range of pesticides and agrochemicals used for soil treatment, hormonal therapy, accelerating the growth of animals and birds, lots of preservatives, stabilizers, flavors, colors , etc.

The System of hazard analysis and critical control points (HACCP) is a systematic approach to the identification, assessment and management at those stages of food production which are critical to food safety. It is an analytical tool that allows to introduce and continuously implement an effective program of ensuring food safety. The main purpose of the HACCP system is to ensure food safety during the production process based on the prevention of hazards rather than finished product inspection [3].

Currently HACCP system has got international recognition and is widely used as a subjective quality system in which decisions are based on qualitative data.

The HACCP system focuses directly on the process control of parameters of the technological process and evaluation of raw materials used in the production of food. It is developed independently by each company in accordance with the characteristics of its production, can flexibly change and adapt.

The main objectives of the HACCP system [2] are:

• to prevent production of hazardous to health food products;

• to minimize the risk of product safety to an acceptable level;

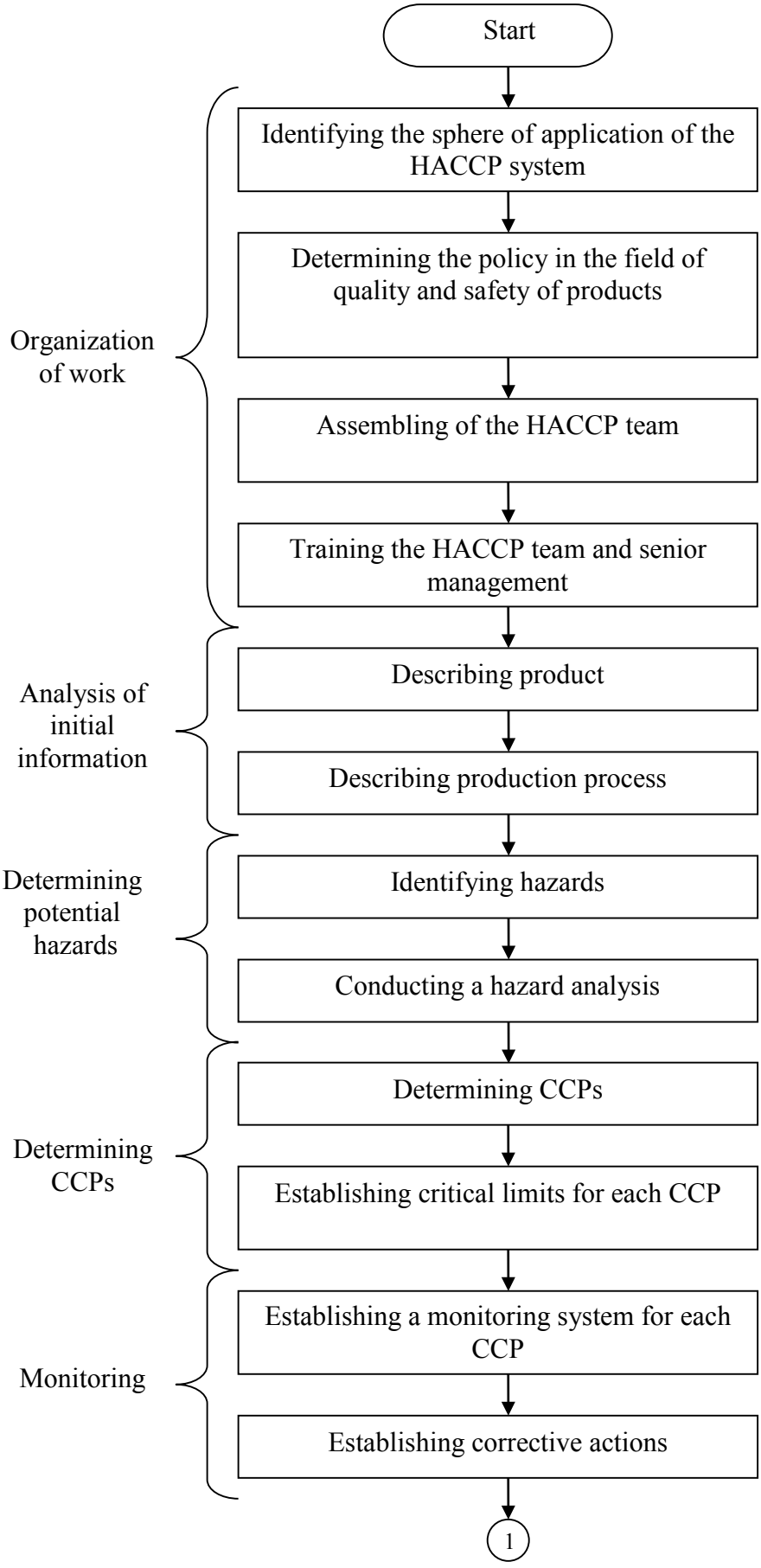
• to create necessary and sufficient conditions for output of safe products;

• to create opportunities for further production improvement.

During the study conducted at JSC "Togliattimoloko" the algorithm for the application of the HACCP system was developed in order to reduce the risks caused by the production, storage and distribution as well as in order to meet the system control requirements at all stages of production (Figure 1).

Development of the HACCP system includes a logical sequence of 14 steps:

• Identifying the sphere of application of the HACCP system.


Start
Identifying the sphere of application of the HACCP system
Determining the policy in the field of quality and safety of products
Assembling of the HACCP team
Training the HACCP team and senior management
Describing product
Describing production process
Identifying hazards
Conducting a hazard analysis
Determining CCPs
Establishing critical limits for each CCP
Establishing a monitoring system for each CCP
Establishing corrective actions
1
Organization of work
Analysis of initial information
Determining potential hazards
Determining CCPs
Monitoring

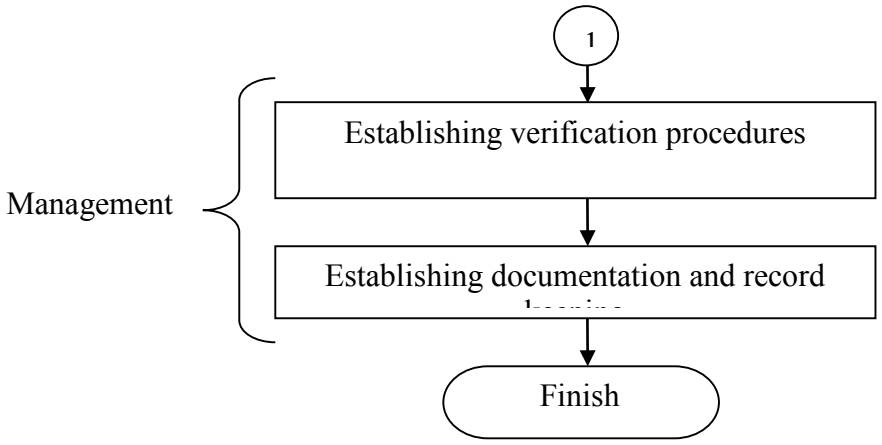


Figure 1 - Algorithm for the application of the HACCP system

Management should determine the sphere of application of the HACCP system for certain types of products (groups or names of products) and for life cycle stages of a product (production, storage, transportation, wholesale and retail trade and consumption, including the sphere of catering).

• Determining the policy of company's management in the field of quality and safety of products.

The company management should define and document the policies regarding safety of products and to ensure its implementation and support at all levels.

Security policies must be practicable and feasible, meeting requirements of government control and supervision as well as consumer expectations.

• Assembling of the HACCP team.

The company management should select and appoint the HACCP team, which is responsible for developing, implementing and maintaining the HACCP system in working order. HACCP team members together should have sufficient knowledge and experience in the field of quality management technologies, equipment and instrumentations maintenance, as well as in the part of the regulatory and technical documents for the products. The group must have a HACCP coordinator and technical secretary, as well as, if necessary, consultants competent in this field.

The company management should determine and timely provide the HACCP team with necessary resources, including:

- time and place for meetings, analysis, self-study and document preparation;
- funds for initial training of team members;
- the necessary documentation;
- access to sources of information;
- necessary software;
- computing and office equipment.

For the effective implementation of HACCP, organization should enlist a HACCP consultant, who has relevant knowledge, experience in developing and implementing such systems.

• Training the HACCP team and senior management.

It is necessary to conduct training of the HACCP team and senior management. In training materials the following information should be included: information on the necessity of introduction of the HACCP system, basic provisions, the HACCP principles, challenges

facing the organization, the role of senior management in implementing the HACCP system, the regulatory framework of the system, the basic stages of HACCP and other issues.

• Describing product.

For each group of products the following information should be specified:

- name and designation of normative documents and standards;

- name and designation of the main raw materials, food additives and packaging, their origin, as well as designations of technical regulations and conditions under which they are produced;

- safety requirements (specified by the regulations) and signs of identification of products;

- storage conditions and shelf life;

- known and potentially possible cases of improper use of the product, and if necessary-recommendations for the use and limitations in the use of the product, including certain groups of consumers (children, pregnant women, diabetics, etc.) with the relevant information in the accompanying documents;

- the possibility of danger, in the case of objectively predictable misuse of the product.

• Describing production process.

Production description can include the scheme of the territory of the enterprise, the scheme of production sites, the list of necessary equipment, technical documentation (processing instructions, schemes of techno-chemical control), and flowcharts of production processes.

Product and production descriptions must be checked for compliance with the actual situation by the HACCP team. This check should be carried out periodically and the results must be documented.

• Identifying hazards.

The HACCP team should identify and evaluate all hazards, including biological (microbiological), chemical and physical, as well as to identify all possible hazards in production processes.

Food safety hazards presented in the sanitary rules and regulations should be included in the list of factors considered firstly and without any changes.

• Conducting a hazard analysis.

A hazard analysis is conducted for each potential hazard taking into account probability of occurrence of this hazard and importance of its consequences; then a list of hazards for which risk exceeds acceptable level is made. If information about acceptable risk is absent, the HACCP team sets it in expert way. The team should define and document the preventive actions that eliminate hazards or reduce these risks to a safe level.

• Determining CCPs.

Critical control points are determined by analyzing each hazard separately and considering successively all operations included in the flashchart of the production process.

Prerequisite to a critical control point is the signs of risk in considered control operation (hazard identification and (or) preventive (control) measures that eliminate the risk or reduce it to an acceptable level).

In order to reduce the number of critical control points without compromising security the points for which the conditions below are true should not be considered as CCPs:

- preventive measures systematically carried out in a planned way and regulated in the Sanitary rules and regulations , in the system of maintenance and repair of equipment, in the quality control procedures, and in other systems of company management;

- implementation of preventive actions which are not related to the control points; they are estimated by the HACCP team and periodically checked during internal audits.

• Establishing critical limits for each CCP.

A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level.

• Establishing a monitoring system for each CCP.

Monitoring system of critical control points is a set of procedures, processes and resources needed for monitoring at these points.

For each critical control point the monitoring system should be developed to ensure that the process is under control in order to timely detect violations of critical limits and take appropriate preventive or corrective actions. Frequency of monitoring procedures should ensure that there are no unacceptable risks.

• Establishing corrective actions.

For each critical control point corrective actions must be defined. These actions are to be taken when monitoring indicates a deviation from an established critical limit in order to eliminate the cause of a detected nonconformity or other undesirable situation in production.

Corrective actions include:

- Verification of measuring instruments;
- Adjustment of equipment;
- Isolation of nonconforming products, etc.

• Establishing verification procedures of the HACCP system.

Internal audits should be conducted immediately after the introduction of the HACCP system and then at specified intervals, at least once a year, or in an unplanned manner when new unrecorded hazards and risks are identified.

Verification procedures should include:

- analysis of registered complaints, claims, and incidents involving violations of product safety;
- conformity assessment in order to determine that the procedures actually executed meet relevant HACCP system documents;
- verification of the preventive actions;
- analysis of the results of monitoring of CCPs and corrective actions;
- evaluation of the effectiveness of the HACCP system and making recommendations for its improvement;
- updating documents.

Verification procedures are developed by the HACCP team and the inspection report is approved by the head of the organization.

• Establishing documentation and record keeping.

The HACCP program documentation should include:

- policy on safety of products;
- order establishing the HACCP team and its line-up;
- product description;
- description of production process;
- the HACCP team's reports including hazard analysis, CCP and critical limit determination;
- the HACCP worksheets;
- monitoring procedures;
- corrective actions;
- program of internal audit of the HACCP system;
- list of registration and accounting documentation approved by the company management and including documents that represent the functioning of the HACCP system, in which you will find:
- monitoring data;

- deviations and corrective actions;
- complaints, claims, and incidents involving violation of the product safety requirements;
- reports of internal audits.

If your enterprise does not have a general procedure, it should establish a procedure for approval, publication and transfer to other individuals and organization, review, coding and registration documents of the HACCP system [5].

HACCP is the original system due to the idea to focus on those process stages and production conditions, lack of control at which is critical for food safety, as well as to ensure that food products will not cause harm to a consumer. HACCP therefore is fundamentally different from previous systems used in the food industry, which were built on "quality control" (only purchased raw materials and end-product were controlled) [4].

When introducing the system, the organization is required not only to examine and describe its own product and production methods, but also to apply this system to suppliers of raw materials, accessory materials, as well as the system of wholesale and retail trade.

Development and implementation of quality management in the enterprise affects all departments and all the staff.

The HACCP system is a powerful management tool, the main function of which is to protect production processes from microbiological, biological, physical, chemical and other contamination risks.

Studies have shown that the HACCP system will improve the scientific basis of hazard analysis.

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TEMPERATURE DISTRIBUTION IN LAYERED BIOLOGICAL TISSUES EXPOSED BY MICROWAVE RADIATION

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Theoretical and experimental results of microwave radiation influence on the multi-layered biological tissues at 2450 MHz electromagnetic field frequency oscillations. Model and analytical calculation method of the temperature distribution inside the volume of biological tissue are presented. The prospects of the microwave radiation therapy are shown.

Keywords: microwave source, temperature field distribution, waveguide, resonator, microwave radiation, biological tissue

Currently microwave radiation receives more and more wide application in the field of medicine. One of the promising new directions in medicine is the microwave therapy. Under the influence of microwave therapy the blood vessels dilate increasing blood flow, spasm of smooth muscles decreases, the processes of excitation and inhibition of the nervous system normalize, the passage of impulses along nerve fiber accelerates, the protein, lipid and carbohydrate metabolism changes [1-2].

Microwave therapy has an anti-inflammatory and analgesic action. Microwave radiation also has a positive effect on the cardiovascular system - improves myocardial contractile function, activates metabolism in cardiac muscle [1-2].

The main problems of scientists are associated with the study of the microwave radiation action on various biological tissues mechanisms, as well as creation of a new hardware impact on the human body in the field of microwave therapy.

Power values of specific heat losses in homogeneous biological tissues are [3]:

$$P_{y\partial} = 0{,}278 \cdot 10^{-12} \cdot f \cdot \varepsilon'' \cdot E^2, \qquad (1)$$

where: f - electromagnetic field oscillations frequency [Hz]; E - electromagnetic field intensity [V/cm]; $P_{y\partial}$ - specific power of heat loss [W/cm^3]; ε'' - the imaginary part of the biological tissue relative permittivity.

The imaginary part of the relative dielectric constant in homogeneous biological tissue (ε'') is determined taking into account its conductivity [3]:

$$\varepsilon'' = \frac{\varepsilon_c''}{\varepsilon_o} + \frac{\sigma}{\omega \cdot \varepsilon_o}, \qquad (2)$$

where: ε_c'' is the imaginary part of the ultimate homogeneous dielectric permeability of biological tissue; ε_o - absolute permittivity of vacuum; σ - conductivity of homogeneous biological tissue; ω - circular frequency of the electromagnetic field oscillations.

The present work contains the results of theoretical and experimental investigations of the temperature distribution in the multi-layered biological soft tissues with different physical parameters. The temperature of soft biological tissues was changed by the impact of microwave radiation emitted from the rectangular waveguide aperture on the main type H_{10} wave at a electromagnetic field frequency oscillations of 2450 MHz.

As a model, simulating the human body, a multi layer structure of biological animal tissues (skin, adipose tissue, muscular tissue) was used. Radio transparent material (polyethylene) was placed between the tissue layers in order not to take into account thermal conductivity between the different layers of the biological tissue.

Microwave radiation energy was applied to multi-layer structure of biological tissues using the antenna in the form of a rectangular waveguide aperture, located at a certain distance from its surface. The electromagnetic field power emitted from the aperture of a rectangular waveguide, working on basic H_{10} wave type, is unevenly distributed in space and is calculated by the Huygens-Kirchhoff's method of [4].

Fig. 1 shows a schematic representation of the radiation emitted from the aperture of a rectangular waveguide, and multilayer structure which consists of various layers of a biological tissue.

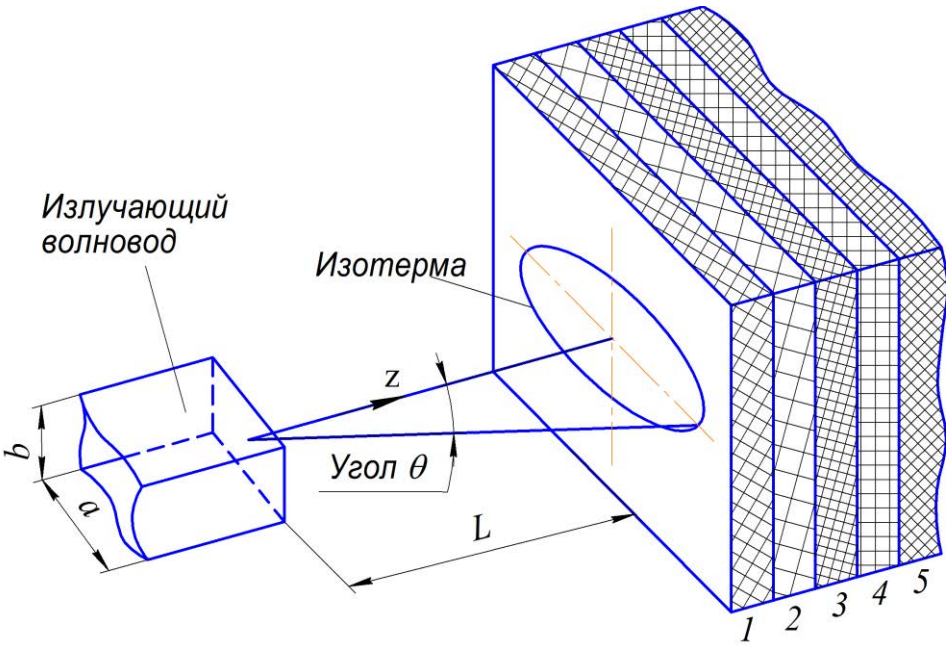

Fig.1. Schematic representation of microwave radiation emitted from the aperture of a rectangular waveguide, and multilayer structure which consists of various layers of biological soft tissues. L - distance from the emitting waveguide to the surface of the irradiated biological tissue.

The averaged parameters of biological tissues at a temperature of $36^{\circ}C$ and electromagnetic field frequency of 2450 MHz are presented in table 1.

Table 1

The averaged parameters of animals' biological tissues (pigs) at a temperature of 36°C and electromagnetic field frequency of 2450 MHz

Biological tissue	ε'	ε''	Density $\rho \cdot 10^3$ kg/m^3	Thermal conductivity W/(m·°K)	Heat capacity kJ /(kg·°K)
Leather	38	6	0,3	0,15	3,2
Fat domestic deposits	5	1,5	0,93	0,2	2,3
Muscle tissue	50	10	1,03	0,48	3,36

Temperature measurement of various layers of biological tissues was held on the central line of the radiating waveguide, along the axis "z", corresponding to the microwave radiation source output maximum value $(P = 550W)$, satisfying condition $(\theta = 0)$, the exposure time $(\tau = 120\text{sec})$ and the distance from the surface of the radiating antenna to multilayer biological tissue $(L = 250mm)$.

Experimental temperature distribution researches in layered biological tissues were held in metal chamber with its size of (600×600×600) mm. Microwave energy source was located

in the center of the camera's top, as shown in fig. 2. For the purity of the experiment absorbent material was placed on the walls of the camera. It was made in order not to take into account the reflection of microwave energy from the walls of the chamber.

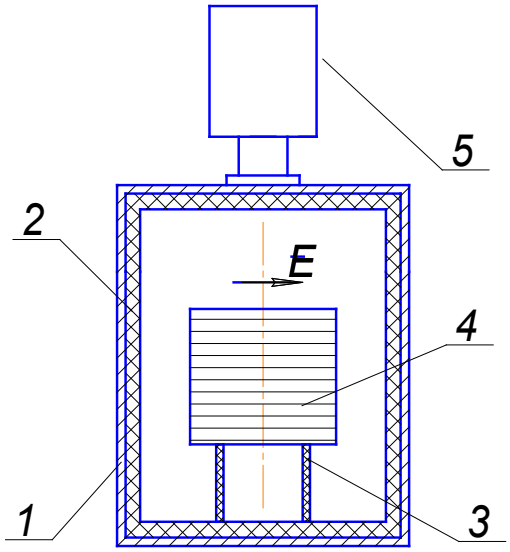

Fig. 2. Design of the camera for experimental studies of the temperature distribution in the volume of the processed material: 1 - metal camera; 2 - absorbing material; 3 - stand of radar material; 4 - layered biological tissue; 5 - source of energy.

Fig. 3 shows a beam-type chamber photograph.

After a biological tissues' multilayer material irradiation, the source of microwave energy was switched off, and the temperature value was measured in the center of each layer using a thermocouple thermometer with accuracy of $\pm 1^{\circ}$ C.

Fig. 3. Photo of the microwave chamber for pilot studies of temperature distribution in the volume of the material.

Results of the temperature distribution in the different layers of biological tissues experimental studies are presented in table 2. The table below shows the sequence of biological tissues' layers, as well as the value of their thickness.

Table 2

The experimental and the calculated temperature distribution in the multi-layered biological tissues (the calculated values of temperature are shown in parentheses)

No. layer bio-logical fabric	Name biological tissue	Layer thickness of the biological tissue (mm)	Initial the temperature of the biological tissue (°C)	Ultimate the temperature of the biological tissue (°C)
1	Leather	2	20	30 (29)
2	Adipose tissue	5	20	26 (26)
3	Muscle tissue	10	20	46 (43)
4	Muscle tissue	10	20	41 (38)
5	Muscle tissue	10	20	37 (35)

Model and the temperature calculation method inside the processed biological tissue is the most important from the point of view of therapy.

Heated multi-layered biological tissue is represented in the form of a half-space in the traveling wave's electromagnetic field. Taking into account the reflection coefficient each layer of biological tissue with thickness ℓ, is represented in the form of a loaded long-distance transmission line with given boundary conditions.

Fig. 4 shows the equivalent circuit of the heated tissue layer with dielectric losses in the traveling wave mode.

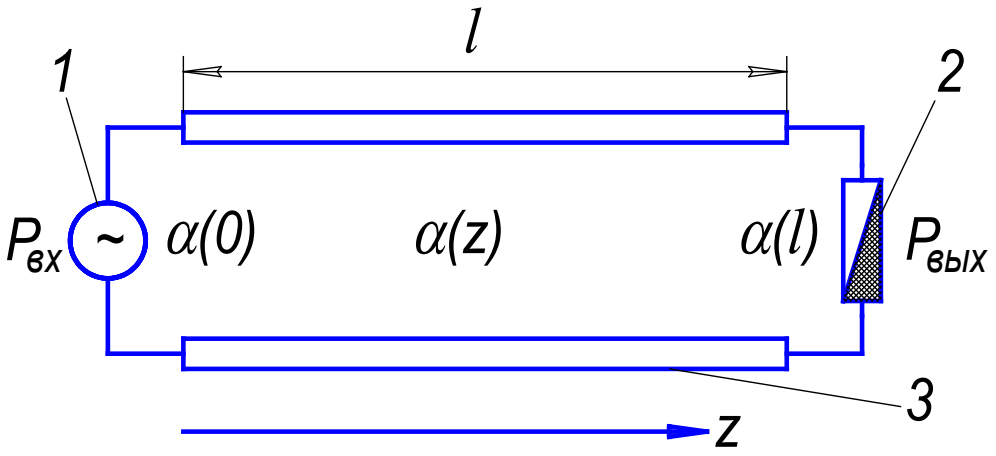

Fig. 4. An equivalent circuit of the microwave energy source with rectangular waveguide aperture as a radiating antenna, and a homogeneous tissue layer with dielectric losses. 1 - a source of microwave energy; 2 - impedance-matched load; 3 - homogeneous layer of biological tissue with thickness ℓ .

Each layer of biological tissue, as shown in [3] can be represented as two similar layers, namely: a layer of absolutely dry matter and water layer, with the use of superposition principle or tissue layer's equivalent parameters that can be defined by different methods.

Work [5] presents the relative dielectric constant experimental dependence on temperature for the water at the electromagnetic field frequency of 2450 MHz, which is linear

and decreases with increasing temperature and for various dry substances which are linear, and increase with increasing temperature.

The amount of power is absorbed by biological material with dielectric losses according to the exponential law. In the first approximation the law of power changes in the material is determined by the electric field intensity amplitude constant decay $\alpha(z)$ in material :

$$P(z) = P_{вх} \cdot e^{-2 \cdot \alpha(z) \cdot z} \tag{8}$$

The relationship between propagation constant in various directions with the free space wavenumber and a homogeneous biological medium's dielectric parameters is determined by the characteristic equation [6]:

$$\Gamma_x^2 + \Gamma_y^2 + \Gamma_z^2 = -k^2 \cdot (\varepsilon' - j\varepsilon''), \tag{9}$$

or

$$(\alpha_x + j\beta_x)^2 + (\alpha_y + j\beta_y)^2 + (\alpha_z + j\beta_z)^2 = -k^2 \cdot (\varepsilon' - j\varepsilon''), \tag{10}$$

where $\Gamma_x, \Gamma_y, \Gamma_z$ propagation constants in various directions; $\alpha_x, \alpha_y, \alpha_z$ electric field amplitude decay constants in different directions; $\beta_x, \beta_y, \beta_z$ - phase constant in various directions; ε' is the real part of the biological tissues' relative dielectric constant [3]:

$$\varepsilon' = \frac{\varepsilon_c'}{\varepsilon_o}, \tag{11}$$

where ε_c' - the real part of the biological tissues' absolute dielectric constant; k - is the wave number for space (vacuum and air):

$$k = \frac{2\pi}{\lambda}, \tag{12}$$

where λ - wavelength of the microwave energy source

.

The characteristic equation (11) can be written in general case, in the form of two equations by equating the real and imaginary parts:

$$\alpha_x^2 + \alpha_y^2 + \alpha_z^2 - \beta_x^2 - \beta_y^2 - \beta_z^2 = -k^2 \cdot \varepsilon', \tag{13}$$

$$2 \cdot (\alpha_x \cdot \beta_x + \alpha_y \cdot \beta_y + \alpha_z \cdot \beta_z) = k^2 \cdot \varepsilon''. \tag{14}$$

These equations relate the phase constant and the electric field amplitude decay constant with the dielectric parameters of biological tissues and the wavelength of microwave energy source.

These equations can be used to define an electric field intensity amplitude decay constant in biological tissues.

According to equations (13) and (14)

$$\alpha_z^2 - \beta_z^2 = -k^2 \cdot \varepsilon', \tag{15}$$

$$2 \cdot \alpha_z \cdot \beta_z = k^2 \cdot \varepsilon''. \tag{16}$$

From the solution of this system of equations (15) and (16) follows:

$$\alpha_z = \frac{k \cdot \sqrt{\varepsilon'}}{\sqrt{2}} \cdot \sqrt{\left(\sqrt{1 + \left(\frac{\varepsilon''}{\varepsilon'} \right)^2} - 1 \right)}, \tag{17}$$

Power distribution in each homogeneous layer of biological tissue in the direction of the axis "z" can be represented in the form [6]:

$$P(z) = f(z,T) \cdot P_{вх} \cdot e^{-2 \cdot \alpha_н \cdot z}, \tag{18}$$

where $f(z,T)$ - taking into account the dependence of the dielectric parameters of bio-logical fabric of temperature and coordinates function.

Experimental dependence of the absorbed power value in material along the axis "z" on the value of the electric field amplitude decay constant has a straightforward character at the electromagnetic field oscillations' frequency of 2450 MHz.

The main point which is used in the derivation of expressions for functions $f(z,T)$ is that, according to the experimental research, the attenuation constant value is a linear function of the absorbed power values:

$$\alpha(z) = A - B \cdot \frac{P_{вх} - P(z)}{P_{вх}}, \tag{19}$$

where *A* and *B* - coefficients, which are determined from the boundary conditions.

We suppose that the whole microwave energy source power is absorbed in biological tissue of thickness ℓ. In this case, from the equivalent circuit model of microwave devices with the irradiated homogeneous biological tissue, we can write the following boundary conditions:

$$\left.\begin{aligned} P(z)\big|_{z=0} &= P_{вх} \\ \alpha(z)\big|_{z=0} &= \alpha_к \end{aligned}\right\}, \tag{20}$$

$$\left.\begin{aligned} P(z)\big|_{z\to\ell} &= 0 \\ \alpha(z)\big|_{z\to\ell} &= \alpha_н \end{aligned}\right\}, \tag{21}$$

where $\alpha_н$ - the electric field intensity amplitude decay constant value at the initial temperature $T_н$ in homogeneous biological tissue; $\alpha_к$ - the value of the electric field amplitude decay constant at finite temperature $T_к$ in homogeneous biological tissue.

From boundary conditions (21) and (22) and equation (19) the coefficients *A* and *B* can be obtained.

$$\alpha(z) = \alpha_к - (\alpha_к - \alpha_н) \cdot \frac{P_{вх} - P(z)}{P_{вх}}. \tag{23}$$

Ratio is known from the theory of long lines [2]:

$$-\frac{dP(z)}{dz} = 2 \cdot \alpha(z) \cdot P(z). \tag{24}$$

Substituting (23) in (24), we obtain the equation:

$$\frac{dP(z)}{\left[\alpha_к - (\alpha_к - \alpha_н) \cdot \frac{P_{вх} - P(z)}{P_{вх}}\right] \cdot P(z)} = -2 \cdot dz \tag{25}$$

Solution of the equation (25) is:

$$P(z) = P_{вх} \cdot e^{-2 \cdot \alpha_н z} \cdot \frac{\alpha_н}{\alpha_к - (\alpha_к - \alpha_н) \cdot e^{-2 \cdot \alpha_н \cdot z}}. \tag{26}$$

Therefore:

$$f(z,T) = \frac{\alpha_н}{\alpha_к - (\alpha_к - \alpha_н) \cdot e^{-2 \cdot \alpha_н \cdot z}} \tag{27}$$

If homogeneous biological tissue has an initial temperature $T_н$, then after its irradiation by the microwave energy, biological tissue obtains the following temperature distribution along the axis “z”:

$$T(z) = T_н + \frac{2 \cdot \alpha_к \cdot f^2(z,T) \cdot \tau}{S \cdot c_д \cdot \rho_д} \cdot P_{вх} \cdot e^{-2 \cdot \alpha_н \cdot z}, \tag{28}$$

where: $c_д$ is the heat capacity of a homogeneous biological tissue; $\rho_д$ is the density of the homogeneous biological tissues; τ - time of homogeneous biological tissue microwave irradiation; *S* is the area of the surface of a homogeneous biological tissue that is evenly heated with the use of microwave radiation.

If the half-space is irradiated, the value of the electric field amplitude decay constant can be written as [6]:

$$\alpha_{н} = \frac{k \cdot \sqrt{\varepsilon'_{н}}}{\sqrt{2}} \cdot \sqrt{\left(\sqrt{1 + \left(\frac{\varepsilon''_{н}}{\varepsilon'_{н}} \right)^2} - 1 \right)}, \quad (29)$$

$$\alpha_{к} = \frac{k \cdot \sqrt{\varepsilon'_{к}}}{\sqrt{2}} \cdot \sqrt{\left(\sqrt{1 + \left(\frac{\varepsilon''_{к}}{\varepsilon'_{к}} \right)^2} - 1 \right)}. \quad (30)$$

The constant value of the microwave power distribution on irradiated area of biological tissues in the calculations was adopted on the area in the form of a circle S =1cm^2.

Calculation was carried out for the layers of biological tissues, presented in table 2 and their electrophysical parameters presented in table 1. Calculated values of temperature in biological tissues are presented in table 2.

Calculation of the temperature distribution in the multi-layered biological tissues, carried out in accordance with the proposed model, confirmed the experimental results. If the parameters of different layers in biological tissues are known, the temperature in the area of interest can be calculated closely to the experimental results.

The obtained results can be used in developing a setup for therapy.

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TEMPERATURE DISTRIBUTION IN SHEET MATERIALS IN A WAVEGUIDE MICROWAVE DEVICES

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The temperature distribution calculation and measurement results for sheet dielectric materials heated up in the microwave waveguide type devices are presented. The calculation method for sheet dielectric materials' heat treatment in a waveguide type microwave devices is presented. Microwave devices, a distinctive feature of which is the rectangular waveguide narrow wall geometrical sizes' change, working mainly on the H_{10} type of wave to ensure a uniform temperature in the processed sheet dielectric material are considered.

Keywords: microwave device, waveguide, power distribution, the distribution of temperature, dielectric material, the source of microwave energy.

Microwave devices are widely used in a high-performance heat treatment for relatively thin sheet dielectric materials [1]. In such microwave devices a rectangular waveguide on the main wave type H_{10} is used as a heating element and the material is transported through the narrow slits cut along the middle of waveguide's broad wall parallel to the narrow walls. Such microwave units are called units with cross interactions [1, 2].

The transported material is thin enough and it can be assumed that the basic wave type H_{10} is propagated in a waveguide.

Let rectangular waveguide with the processed material be ideally matched with a source of microwave energy on one side, and with a water load on the other side. We assume that the heat emission in the surrounding space and the ohmic losses in the waveguide are small and they are not taken into account in calculations. The electromagnetic field energy propagates along the "z" axis, and the processed material's width is ℓ in the electromagnetic power propagation direction.

The spreading through the waveguide power fades in processed material by the exponential law:

$$P(z) = P_{вх} \cdot e^{-2 \cdot \alpha_z \cdot z} \ , \tag{1}$$

where $P_{вх}$ is the output power of the microwave energy source; α_z - electric field amplitude decay constant in the material along the axis "z ".

The ratio for engineering calculation of constant attenuation in a waveguide with a relatively thin material, situated in the middle of the wide side parallel to the narrow, can be obtained by a generalization of the equivalent circuits method for a waveguide with a H_{10} wave type with homogeneous filling [2]. The electric field amplitude decay constant value in the material is determined by the relation [2]:

$$\alpha_z = \frac{\pi^2 \cdot d \cdot \varepsilon''}{2 \cdot a \cdot \lambda \cdot \sqrt{1 - \left(\frac{\lambda}{2 \cdot a}\right)^2}} \ , \tag{2}$$

where ε'' - the imaginary part of the material's relative permittivity; a size of the waveguide's wide side; λ - microwave energy source wavelength; d thickness of the material.

The amount of power transmitted through the waveguide:

$$P(z) = P_{вх} \cdot e^{-\frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z}. \quad (4)$$

The value of linear power loss:

$$P_{пог}(z) = \frac{dP(z)}{dz} = P_{вх} \cdot \frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot e^{-\frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z}. \quad (5)$$

Specific power loss is equal to the relation of linear power losses in the cross section of the material:

$$P_{уд}(z) = \frac{P_{пог}(z)}{S} = \frac{\pi^2 \cdot \varepsilon''}{a \cdot \lambda \cdot b \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot P_{вх} \cdot e^{-\frac{\pi^2 \cdot d \cdot \varepsilon''}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z}, \quad (6)$$

where: S is the area of the cross section of the material; b - the size of the waveguide's narrow walls.

Temperature distribution in the material in the electromagnetic power propagation direction is:

$$T(z) = T_{нач}(z) + \frac{\pi^2 \cdot \varepsilon'' \cdot P_{вх} \cdot \tau}{c_д \cdot \rho_д \cdot b \cdot a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot e^{-\frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z}, \quad (7)$$

where $c_д$ is the heat capacity of the processed material [J/(g·°K)]; $\rho_д$ is the density of the processed material [g/cm^3]; τ - material's processing time in microwave device [sec].

For sheet materials, as a rule, microwave devices consisting of two waveguide sections, with the same design and parameters, but having mutually opposite direction of the electromagnetic field energy propagation are used [3]. In such electrodynamic systems' sections

temperature in the material decreases exponentially in the electromagnetic power propagation direction. The addition of two exponential temperature distribution dependences in the material after the passage through two microwave heating device sections should ensure the temperature distribution in the material satisfying the technological process conditions.

As an example, figure 1 shows a microwave device, and fig.2 shows the calculated and experimental characteristics of the temperature distribution in the material after the passage through two sections of microwave devices, which uses the waveguide sections of constant cross-section.

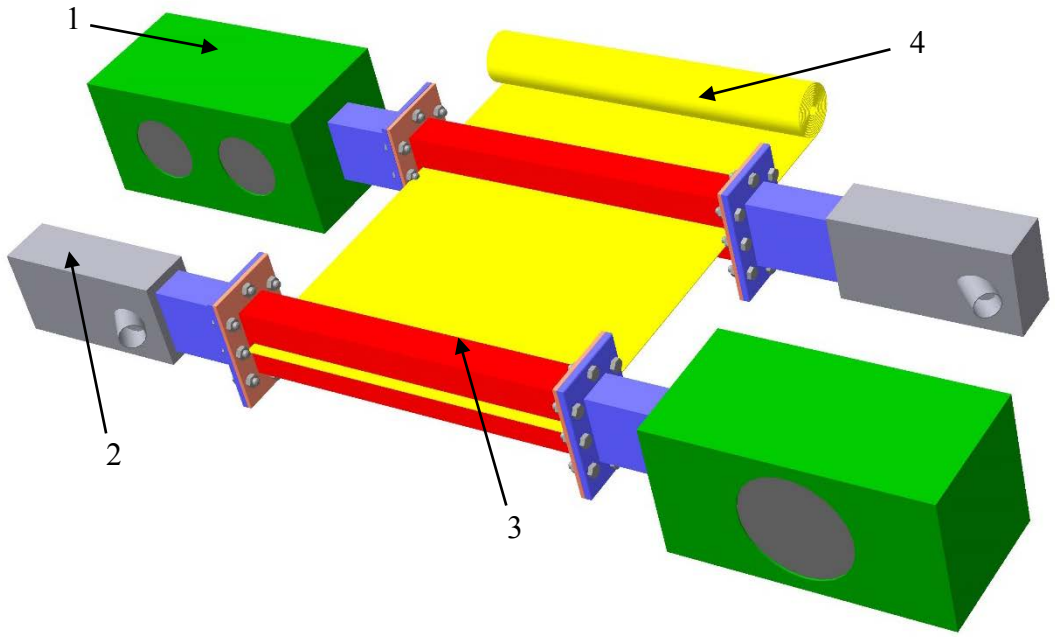

Fig. 1. MW heating device, consisting of two rectangular waveguide sections with constant cross-section: 1 - MW energy source; 2 - water load; 3 - a rectangular waveguide; 4 - processed sheet dielectric material with width ℓ .

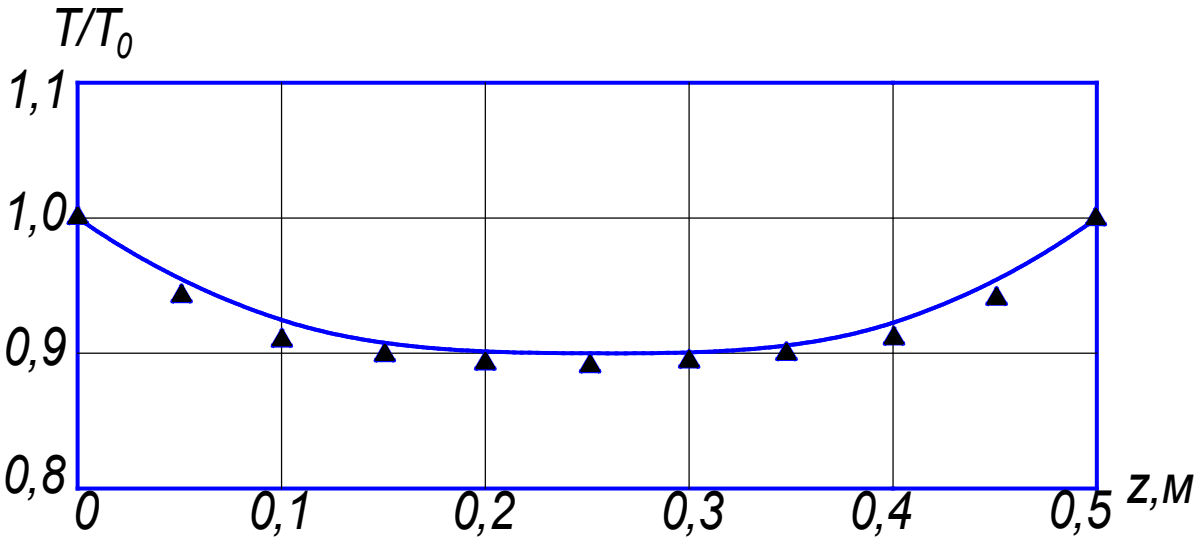

Fig. 2. The calculated and experimental characteristics of the temperature distribution in sheet dielectric material after the passage through two MW heating device sections shown on Fig.1.

Temperature deviation in the material from the nominal values of temperature after the passage of two MW heating device sections did not exceed 12%, and the discrepancy between the calculated and measured values of the temperature distribution in the material does not exceed 6%.

The electric field amplitude value in the material in the electromagnetic power propagation direction can be kept constant by changing the waveguide narrow walls size by a certain rule.

For stationary case (material standing), the constant temperature condition in the material in the microwave energy propagation direction is determined by the expression:

$$T(z) = T_{нач} + \frac{\pi^2 \cdot \varepsilon'' \cdot P_{вх} \cdot \tau}{c_д \cdot \rho_д \cdot b(z) \cdot a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot e^{-\frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z} = const . \quad (8)$$

To satisfy the condition (8) it is necessary and sufficient that the size of the waveguide narrow walls is changed by a rule in the electromagnetic power propagation direction:

$$b(z) = b(0) \cdot e^{-\frac{\pi^2 \cdot \varepsilon'' \cdot d}{a \cdot \lambda \cdot \sqrt{1-\left(\frac{\lambda}{2 \cdot a}\right)^2}} \cdot z} . \quad (9)$$

Fig. 3 shows the MW heating device, consisting of two identical waveguide sections with waveguide's narrow walls size changes according to the linear rule.

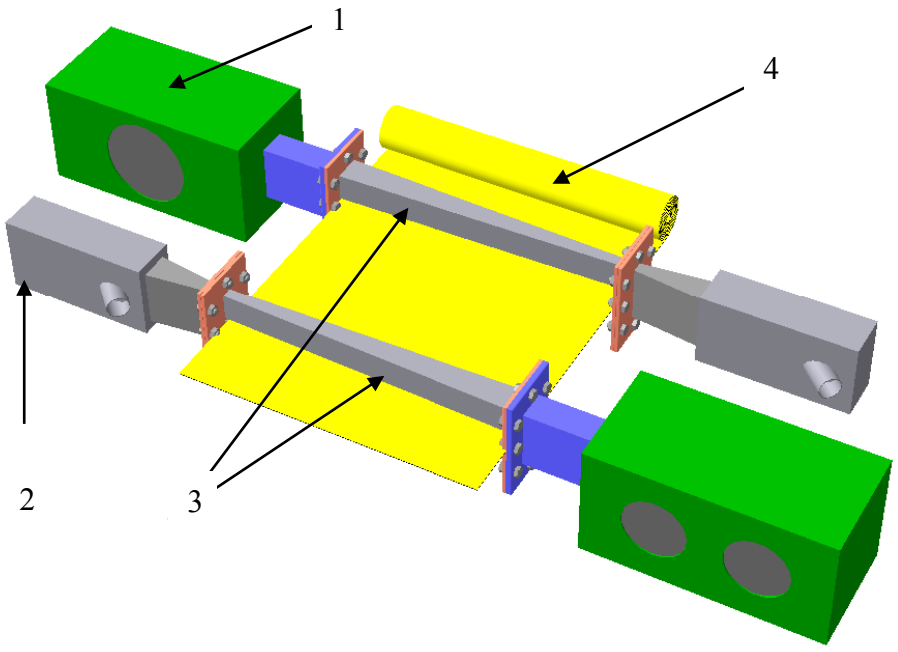

Fig. 3. Microwave device, consisting of two sections with the waveguide narrow walls size linear change. 1 - microwave energy source; 2 - water load; 3 - a rectangular waveguide; 4 - processed sheet material.

Fig.4 shows the calculated and the experimental temperature distribution characteristics in material after the passage through two sections of microwave devices with the waveguide narrow walls size linear change in the electromagnetic power propagation direction.

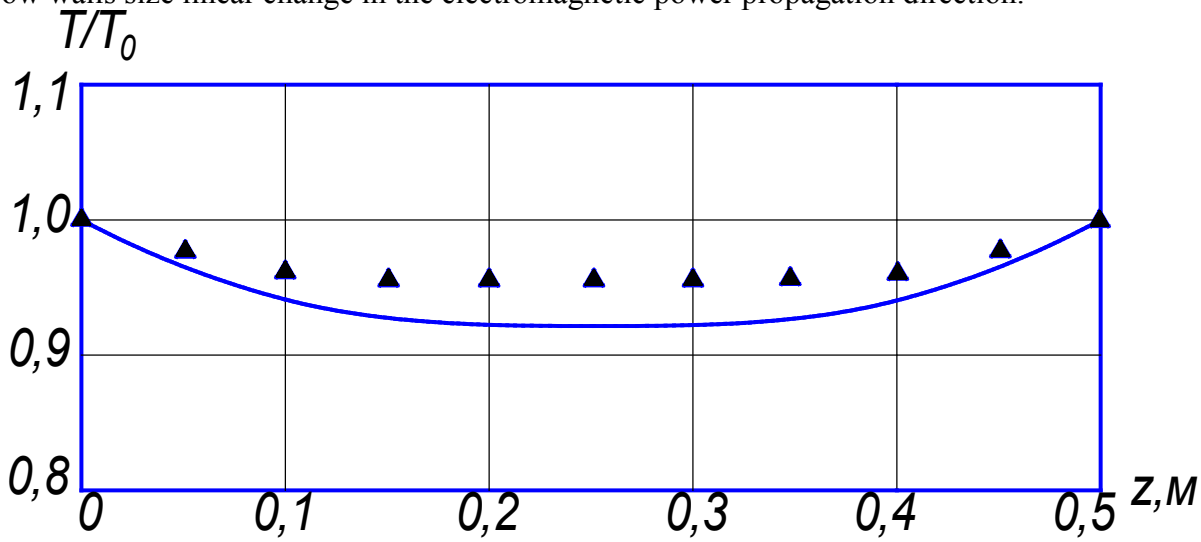

Fig. 4. Temperature distribution in the material after the passage through two microwave devices' sections, shown in Fig. 3.

Temperature deviation in the material from the nominal values of temperature after the passage through two MW heating device's sections does not exceed 9% , and the discrepancy between the calculated and measured values of the temperature distribution in dielectric sheet materials heated from 20°C to 180°C does not exceed 6%.

Section of microwave devices and material are characterized by the following parameters:

- electromagnetic field oscillations operating frequency, MHz ……. 2450
- voltage standing wave ratio in the frequency range of 100 MHz, not more than..... 1,3
- standing wave ratio at the operating frequency ……. 1,17
- microwave energy power source output, kW …….. …0,6
- the length of the waveguide section ℓ, mm……..… 500
- the size of the wide side of the waveguide, mm ……72
- the size of the narrow wall at the beginning of the waveguide, mm .....… 34
- the size of the narrow wall at the end of the waveguide, mm ……. . 15
- temperature of material $T_к$, °C …… .180
- the relative dielectric constant value of the material, ε'' ……..... 0,15
- heat capacity of the material c_∂, J/(g·°K) ……...……..... 0,8
- the density of the material ρ_∂, g/cm^3..... 2,4
- material thickness d, mm ……..……6,0

It is clear that temperature distribution in the material is more uniform when the waveguide narrow walls linearly change from 34 to 15 mm at 500 mm length in comparison with constant cross-section waveguide.

The obtained results can be used in practical elaborations.

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FEATURES OF INFORMATION TECHNOLOGY IN THE MANAGEMENT OF QUALITY

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Abstract: Quality control process is accompanied by a sharp increase in the number of issues papers, the difficulty finding the necessary information, the complexity of service data flows and processes in modern management systems. Therefore, this article highlights the important issues of information support of the product life cycle and use of information technology in management processes, marked signs of the classification of information tools and technologies to manage quality processes.

In the view of intensive globalization of world economy, targeting the activities of organizations in the consumer requests a process approach is particularly relevant, as the main element of management in the organization.

Implementation of the analysis of the main indicators of the processes with a corresponding adjustment is an essential tool for identifying effective ways to improve processes.

Directions for improving the quality of processes can be achieved with due speed and quality of dissemination of information to all personnel involved in the processes that become possible with the systemic use of information technology to facilitate the mapping and process modeling, automation, product life cycle (PLC) support of products, goods and services.

The main purpose of the automated information technology (IT) to get through the processing of raw data of a new quality information on which to base management decisions are produced, representing a process consisting of well-regulated rules of operations over the information circulating in the information system.

At each stage of the life cycle it is generated by a specific set of decisions and reflects their documents, and for an appropriate stage in the original documents and decisions are made at the previous stage.

Consider the classification of information technology, used for quality control processes on the basis of features provided by V.K. Fedyukin [4] (Figure 1).

So for the modeling of processes and quality management process modeling now developed quite a number of software tools (methodology in the Guidelines of State Standard R 50.1.028-2001) [1]

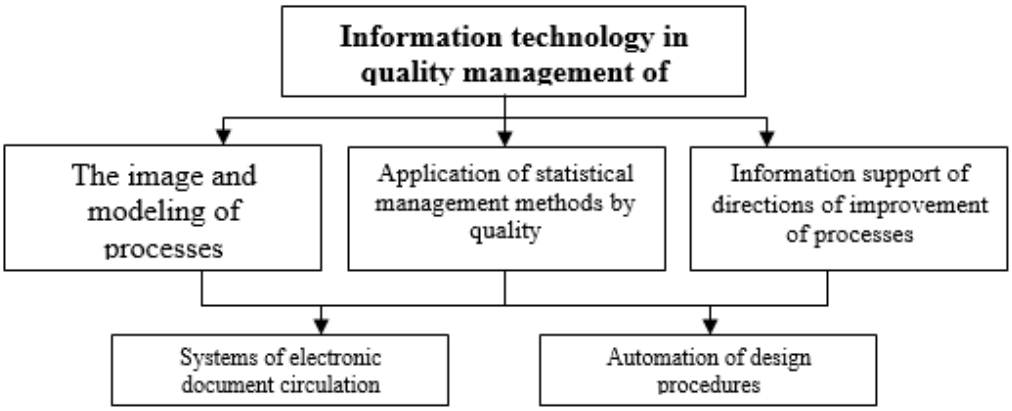

Figure 1. Classification of information tools and technologies to manage quality processes

Software that is versatile for displaying processes, which include the application package Microsoft Office - Microsoft Word, Microsoft Power Point, Microsoft Visio, as well as Micrografx Designer, Corel DRAW;

- A special standard software to display the progress of processes in the form of flow diagrams (Flowcharts) ABC Flowchart, Flowmodel;
- Special software for a general description and modeling (ARIS, Micrografx Optimal, process modules of SAP);
- Special software for a general description and functional modeling of processes (methodology IDEF0) BPwin.

Signs of the classification methodologies and software products in quality management processes are shown in Figure 2.

In quality management processes it is important to consider the problem of a sharp increase in the number of documents: difficulty of finding the necessary documents, keeping them up to date, preservation, confidentiality, etc. Address emerging problem situations contribute to electronic document management systems that reduce administrative costs for document management, increase the efficiency of decision making.

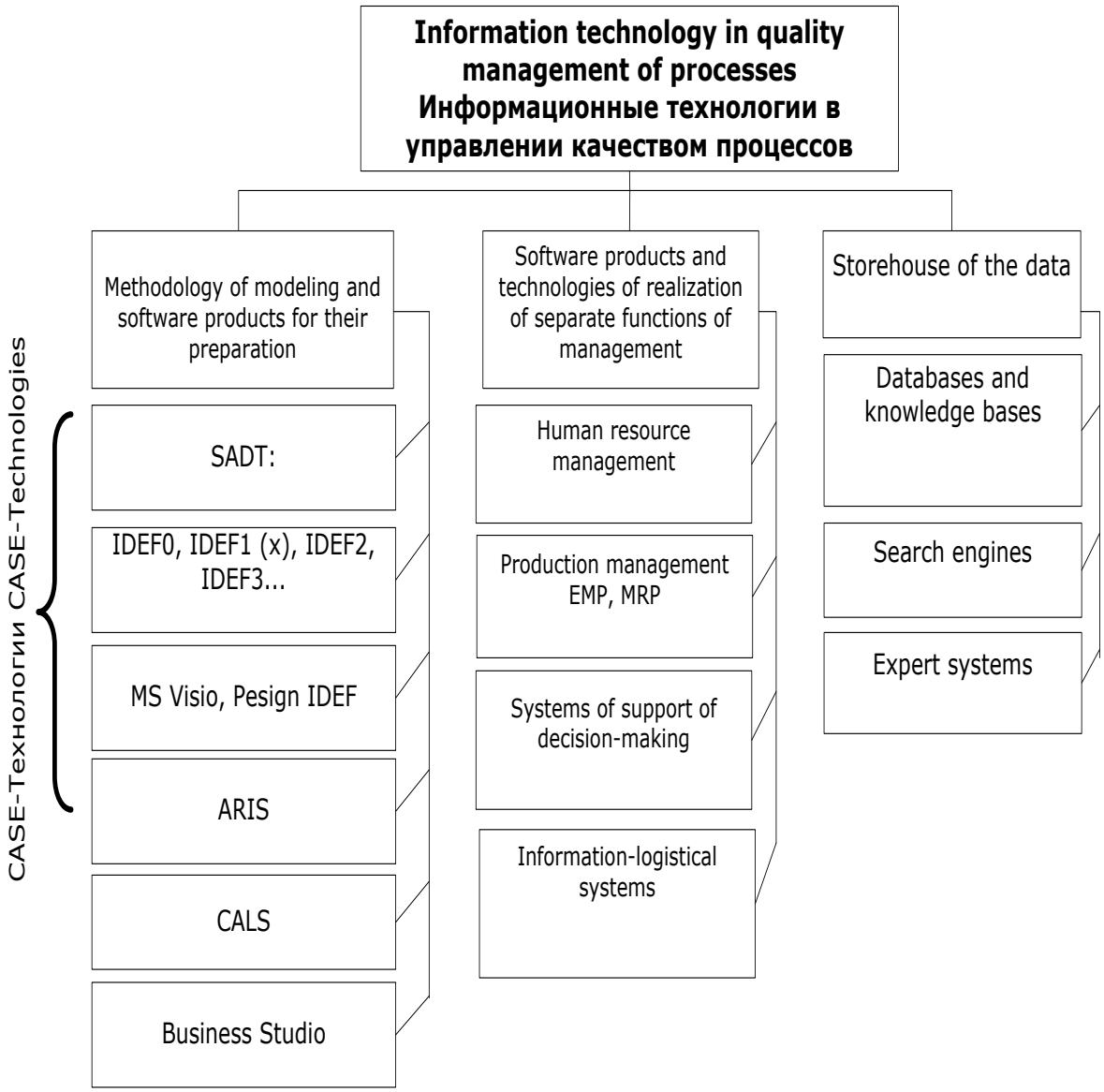

Figure 2.Classification of methodologies and software products in quality management processes

It is interesting now to use the information support system using LCP Business Modeling Business Studio.

Business Studio is a system that allows companies to accelerate and simplify the development of its management, the introduction of quality management system.

Business Studio System designed to support the full cycle of designing an effective system of management of the company - "Design - Introduction - Control - Analysis." Standards-based process modeling using BPMN, with process definitions persisted and exchanged using XPDL. Perform simulations to validate processes and identify costs, times, bottlenecks, or underutilized resources.

Organization modeling to define the organization structure and attributes. These are key aspects in the behavior of business processes.

The process of designing and improving governance can be represented in the following sequence of steps, (see Table 1).

Table 1.

Stages in the process of designing and improving the management system, using Business Studio

Stages	Objectives	Implementation in Business Studio
Design Проектирование	The formalization of the strategy	Strategy maps among MS Visio; support the introduction and use a balanced scorecard / system of key performance indicators (BSC / KPI)
	Designing of Business Processes	Notation used modeling (diagram in the medium MS Visio): IDEF0; Process (Basic Flowchart); Procedure (Cross Functional Flowchart); EPC (Event Driven Process Chain); Supports unlimited vertical decomposition model, built-in tools to control the rules of the selected modeling notation.
	Designing the organizational structure	Designing the organizational structure of management, reflecting the distribution of authority and responsibility for the execution of business processes, organizational structure diagrams Automatic generation of MS Visio; Carrying out the calculation of the required number of employees (full-time schedule optimization).
	Simulation modeling and value analysis (FCA)	Simulation modeling of run-time engineered business process (allowing a probabilistic algorithm run / flow), to calculate the value of a business process based on their consumption of time and material resources (value analysis process) and the optimization of business process analysis.
	Development of TOR for implementation of information systems	Binding of the functional IT system to the functions performed within the designed business process Automatic generation of TK-based built-in report template (.Doc), which is easy to adjust to the needs of the company.
Implementation Внедрение	Formation of regulatory documentation	Regulations of business processes; job descriptions; provisions of subdivisions; Description of documents; friendly report wizard, allowing, without programming, to create / modify templates of any reports at its discretion, ability to design and use of corporate identity; wide range of support reports encompass work modeling and analysis of business processes; Ability to update all operational documents automatically.
	Bringing documents to employees	The conclusion of any regulatory documentation in MS Word to print - presentation on receipt of staff; in electronic form output documentation in HTML-navigator (the static corporate web-site).

Control Контроль	Monitoring of indicators	Ability to monitor the achievement of planned levels of indicators: directly in the Business Studio; reports generated by the values of parameters in the format MS Word, with automatic e-mail distribution to interested parties; with a special module Cockpit.
Analysis Анализ	Analysis Performance	Performance analysis of the dynamics, analysis of plan-fact, decomposition of the calculated indicators, construction of control charts parameters (in accordance with GOST R 51814.3-2001 "Methods of Statistical Process Control").
	Analysis of the discrepancies and their consequences	Maintaining a database of identified nonconformities (including use of the module Cockpit); analysis of discrepancies and their causes with the use of diagrams Ishikawa
	Closing the circle	Planning for corrective and preventive actions.

Use of information technology in quality management process contributes to the creation of competitive advantage organizations, namely, increases the validity of decisions made at the expense of operational data collection, transmission and information processing, provides timely management decision-making organization in a market economy promotes growth management through the timely submission necessary information managers at all levels of a single information management fund.

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EVALUATION OF THE EFFECTIVNESS OF CAR SAFETY SYSTEMS

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The purpose of this article is to offer a method of evaluating the effectiveness of active safety, taking into account the statistics of premiums for alarms of different groups. This method allows to estimate the potential economic results of the installation of different systems of active safety.

Keywords: efficiency, active safety systems, vehicle

The main purpose of the systems of active safety of the car is to prevent emergency. When this situation occurs, the system itself (without driver) assesses the likely danger and, if necessary, prevents her through active intervention in the management of the car.

The use of active safety systems allows various critical situations maintain control of the vehicle or, in other words, maintain directional stability and controllability of the car. The most famous and popular systems of active safety are:

- anti-lock braking system;
- traction control system;
- electronic stability control;
- electronic brakeforce distribution;
- brake assist system;
- pedestrian detection system;
- electronic differential lock.

Listed active safety systems are structurally connected and closely interact with the brake system of the car and greatly increase its effectiveness. A number of systems can control the amount of torque the engine control system.

There are also auxiliary systems of active safety (assistants), designed to assist the driver in difficult in terms of driving situations. In addition to timely warn the driver about the dangers of the system carry out and the active interference in the operation of the car, using the brake system and steering. A large number of such systems to get in connection with the rapid development of electronic management systems (the emergence of new types of measuring devices, improved performance electronic control units).To support active safety systems include [1]:

- parking system;
- system of the circular review;
- adaptive cruise control;
- system of emergency steering control;
- assistance system movement along the strip;
- a system of assistance in rebuilding;
- night vision system;
- traffic sign detection
- control system driver fatigue
- assistance system during descent;
- hill start assist;

At the same time there are no methodologies to compare different systems of active safety on the effectiveness of their work. Simultaneously there is a serious study of road accidents. In 2011 was determined statistics [2] road traffic accidents (RTA) is shown in table 1.

Table 1

Statistics of road accidents for violations of traffic Rules

Type of violation	Percentage of accidents
Mismatch speed specific conditions	8279 (32%)
Other violations	6295 (24%)
Non-observance of priority junction passing	4606 (18%)
Wrong choice of the distance	2178 (8%)
Drive into oncoming traffic	2092 (8%)
Drunk driving	1443 (6%)

Violation of the rules of overtaking	550 (2%)
Exceeding the established speed	466 (2%)

This statistics does not allow to evaluate efficiency of systems of active safety. For this reason, were considered the typical schemes used in a simplified registration of documents for road traffic accident [3].

They can be grouped as follows:

group1 - traffic accidents that occurred when traffic in one direction;

group 2 - traffic accidents caused by the movement of vehicles in opposite directions;

group 3 - road traffic incidents occurred when driving vehicles under the angle to each other;

group 4 - traffic accident occurred while reversing;

group 5 - traffic accidents that occurred when running the course of the vehicle.

To compare the effectiveness of systems of active safety was calculated payout percentage for groups of the total amount of payments for all schemes accident [4].

Table 2

Payment schemes according to the groups accident

Group	Payment, roubles	Percentage of the total amount of all payments
1	357 170 264,97r.	76,62
2	18 788 363,88r.	4,03
3	27 970 536,88r.	6,00
4	24 282 013,91r.	5,21
5	37 972 731,38r.	8,15
Total	466 183 911,02r.	100,00

As table 2 shows, the most significant by the amount of payments of the group accident are:

• group 1 - traffic accidents that occurred when traffic in one direction (76,62% of total payments);

• group 5 accidents occurred at running worthwhile vehicle(8,15% of total payments).

Having analyzed the possibilities of the systems of active safety of the car, were singled out those of them, which allows to reduce the probability of an accident for the most important groups, i.e. groups 1 and 5. These include:

• emergency braking system;

• aid system rebuild.

Selected active safety systems when installed on a vehicle significantly reduce the likelihood of accidents, although not exclude this possibility completely. The proposed approach allows to evaluate the economic feasibility of the installation of the systems active safety, and given the availability of these systems in the calculation of the insurance premium enable insurance companies to provide its customers with more flexible terms and conditions of insurance, and most importantly, lower the cost of insurance.

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MATHEMATICAL METHODS AND ALGORITHMS FOR DECISION SUPPORT TO ENSURE ENERGY EFFICIENCY

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The aim of this paper is to develop methods and algorithms for decision support in the field of energy efficiency of boiler installations. Was developed mathematical model of multiple linear regression.

Keywords: regression multivariate model, prediction, boiler installations, energy efficiency.

Oil production is a complex manufacturing process, including well exploration, drilling and repair, water, sulfur, paraffin crude oil refinery process and many others.

Thermal energy is necessary for industrial objects of the extracting companies' activity.

Boiler installations represent a complex of technologically connected thermal power plants located in isolated industrial buildings with boilers, water heaters and boiler auxiliary equipment designed to produce heat.

Energy efficiency is characteristic reflecting the ratio of the energy resources usage useful effect to the cost of energy produced in order to obtain such effect, with reference to production and technological process.

The purpose of the research is to develop methods and algorithms for decision support in the field of energy efficiency of boiler installations.

Objectives of the study in this work are: the development of regression multivariate model, depending on the production of heat energy from a variety of factors, as well as the time series parameters of the boiler systems future values forecasting to detect and prevent the causes of the resources excessive consumption for the thermal energy production.

Time series data were obtained from sensors 5 boiler installations. Boiler plants equipped with the same modifications 3 boilers and work on the same heat-carrier. But ceteris paribus on the production of the same amount of heat these boilers consume different amounts of resources.

The considered boiler plants are equipped with boilers "STG - Classic," which consist of two modules. Boilers operate on gaseous fuels. The nominal capacity is 0.4 MW. These boilers are designed for industrial, administrative and residential buildings heating and hot water supply. Each boiler module is equipped with a cylindrical cast-copper heat exchanger and burner premix supercharged.

Mathematically, the problem is formulated as follows. Let $x \in X$ be the current state of the object (electrical installation), defined on the set of states $y \in Y$ is the set of states of the response function, as it can act as a natural fuel consumption or electricity consumption.

It is impossible to be limited to the single model in case of complex systems based on experimental data. We can find an infinite set of equations that have identical or nearly identical symptoms for each object, considered as a black box. However, the logic of scientific research requires selecting one or more mathematical models of optimal structure. A certain set of equations of varying complexity is generated and the best of them are selected according to some criteria to solve this problem.

The mathematical model of multiple linear regression of the form is considered in this work:

$$y_k = \theta_{1k} x_{1ki} + \theta_{jk} x_{jk} + ... + \theta_{ml} x_{ml} + \varepsilon_k, \quad i = \overline{1,n}, \quad j = \overline{1,m}; \quad k = \overline{1,l} \ (1)$$

where y_k is the value of the dependent variable in the k-th layer observations; x_{ml} is known value of the independent variable in the k-th layer m - line observations; θ_{jk} is an unknown coefficient at the i explanatory variable; ε_k is the random component.

Gas flow for heat energy is the dependent variable in the developed model. Was found 28 independent variables, including:

- The volume and pressure of water in the feed pipe;
- The temperature of the flue gases and water in boilers;
- Pressure steam boilers;
- Ambient temperature;
- Wind speed.

Model (1) coefficients calculation was made by step-by-step search by means of the least squares method.

Validation of the model was performed using Fisher's exact test. And she showed a high degree of veracity.

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MODELING IDENTIFICATION SYSTEMS AND AIR TRAFFIC CONTROL IN MATLAB

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Kazan

Modeling identification systems and air traffic control (hereinafter, IS AND ATC) is carried out in the framework of a large work on the development of hardware and software simulation radio electronic information and communication systems. During the development of IS AND ATC solves the following main tasks: development of the concept of building a system simulation, selection of Software Tools for modeling IS AND ATC and argumentation selection, ensuring the required level of system reliability, Software Development.

Introduction

Technologies of software-defined radio systems are relevant in our time and in the development and implementation of these technologies might be interested businesses and organizations of radio electronic industry all over the World. SDR technology were able to secure exceptional flexibility, economic efficiency and technical potential for rapid development of wireless communication systems, including systems for special purposes, thus providing new opportunities and for both developers and for producers.

Usually, for modeling accommodation base stations are used special software geo-information systems, usually, for modeling accommodation base stations are used special software geo-information systems, however, for efficient distribution for frequency resources must be considered peculiar properties communications systems (spurious characteristics, modulation scheme, signal level). This problem can be solved with a software simulation, but more accurate results are obtained by using a hardware-software model, when at the hardware level, may be implemented signal formats, features equipment and perform tests with real signals. In this case, all the information will be collected and analyzed on a computer and allow use the material obtained in further studies.

This article will be told about our concept of modeling the system identification and air traffic control, why we decided to use Matlab, and also about how we can achieve a high level of system reliability.

At present, the problems of building and research systems for various applications and signals of different kinds occupy a prominent place in modern science. An important aspect here is the fact that the model of the system must be adequate substitute for a real system itself.

The system modeling and identification of air traffic control presented a number of requirements such as controllability, reconfigurability, adaptability, openness and integrability, based on which were formulated requirements for modeling and identification system of air traffic control:

- The ability to model and design of control systems analysis, calculation and visualization of radio components;
- Ability to signal and image processing, and transfer of, the presence of digital filters;
- The ability to quickly test the ability to work the system components;
- Supports the most common equipment;
- Integrability with other software tools, and in particular with the programming environment LabView, which is based on the hardware;
- The availability of a wide range of consumers.

Matlab software package contains a list of necessary libraries and Simulink graphical modeling environment and meets the specified requirements. Will also be used Stateflow, to simulate the logic of events, it is necessary to provide fault tolerance (reliability) system.

In each mode, the system identification is present three main types of response signals, namely:

- Staff response signal;
- Locating signal;
- The distress signal or failure.

In the course of research work " Development of a layout the technology flashing defendant identification system MkXA and air traffic control systems ATCRBS» were obtained the following results:

- Analyzed specified modes and formats specified requirements interrogations and response signals corresponding to the organization's procedures for information exchange.
- Conducted patent research and identified a number of analogues.
- It developed conceptual design the technology and the defendant was done selection of software and hardware based on the decisions of National Instruments.
- Developed the basic functions mock the technology defendant.
- It developed hardware configuration layout the technology defendant. The prototype consists of a the technology defendant reprogrammable digital transceiver operating at an intermediate frequency - NI 5641R, the central processing unit which is FPGA VIRTEX 5, running NI 8133 embedded controller. In addition, it is composed of blocks of frequency converters NI 5600 and NI 5610, offering transfer frequency up and down. All modules are included in the NI 1075 chassis edinoePXIe.
- The software for critical functions that implement the required specifications layout the technology flashing defendant. Retrieved providing a predetermined minimum time for processing a received interrogation signal is 3 microseconds.

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PRODUCTION COSTS MANAGEMENT USING MATHEMATICAL MODELLING

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The paper considers “costs – output” model for production of goods which are not stored, basing on regressive-autoregressive equations.

Keywords: regressive-autoregressive equations, reinvestment vector, model phase.

Introduction

Any organization can be viewed as an economic object with specific structure, inputs and outputs. This allows to use quantitative modelling of its activities in order to find adequate (best) and sometimes optimal or rational (basing on the chosen criteria) management decisions.

The mechanisms of organization systems management using dynamic management methods and graph and games theories were analyzed in [1, 2].

The paper describes regressive-autoregressive model “costs-output” and its application in the agribusiness. This discrete dynamic model was drafted in [3] and further developed in [4

÷ 6].

Information technology presented in this paper is perspective for example for modelling agribusiness companies because it allows to take into account time lags separating resources and produce flows from cash flows, and effectively manage the organization, e.g. provide information support when insuring economic risks and forecasting innovations development in agribusiness [7].

Research problem and limitations

Let's consider application areas for "costs-output" model, its parameters and limitations. When building the model the following limitations were considered:

1. The organization produces one type of product homogeneous in quality customer value and costs. This limitation requires homogeneity of production facilities, i.e. the model cannot be used if production employs different machine types or has several plants with different production efficiency. Moreover, it is assumed that production facilities will remain homogeneous throughout modelled period, i.e. means of production will not deteriorate, and their efficiency changes will be synchronized in time.
2. Organization products at each moment of time will be sold at a single price, and income of the organization of each unit is the same. This condition of homogeneity of sales income of the organization limits marketing policy of the organization. All available cash is used for production. It is assumed that the organization does not use capital markets for investments and does not keep a stabilizing fund of liquid assets as an insurance against market changes, which are characteristic for agribusiness.
3. Products inventory does not affect organization expenditures.
4. All taxes paid by the organization take the form of sum-total of turnover tax (tax paid from the turnover during a certain period of time) and income tax (tax paid from the difference between income and organization production expenditures). It is also assumed that taxation period coincides with modelling stage. This is a serious limitation because as a rule tax legislation is complicated and can not be so simplified.

In the case of Russia this tax conditions corresponds to the simplified taxation system, when the tax payer is paying a single turnover tax and fixed payments to federal funds.

These limitations allow to use this model only for small and medium companies producing one type of product while for big diversified companies the model cannot be used without major changes. However in this case the model can be used for separate production units which meet the above requirements, but it will also require absence of cross-financing between production units and also special attention should be paid to calculating taxes of such production unit.

Compared to previous models of this type some inadequacies leading to infinite growth of production under certain structural parameters combination have been corrected.

For description of the mathematical model of production process the following parameters and variables have been used:

1. Fixed costs EC – costs of the organization which do not depend on the volume of production (wages and salaries, rent, payments to federal funds, etc.)
2. Variable costs EV – costs for producing one product unit стоимость (raw materials, electricity, etc.).
3. Product life m – period (in model cycles), during which the product maintains its customer value and can be sold. After this period all remaining product balances are debited.
4. Income tax r – tax paid on the difference between income and costs.
5. Turnover tax q – tax paid from the organization sales.

6. Reinvestment vector $a = (a_1, a_2, ..., a_m)$ – vector characterizing the speed with which money invested in production is returned.

Organization management is dome by changing the following parameters.

1. External cash flow at the step *t*: F_t – cash flow not connected with economic activities (investments, loans, profit withdrawal, credit payments, etc.)
2. Price of one product unit *P* – money received by the organization from selling this unit.

Internal conditions of the organization are defined by two variables.

1. Production volume at step *t*: Q_t – number of product units produced during step *t*.
2. Circulating assets at step *t*: VR_t – volume of resources used to produce goods at step *t*.

When building the model it is assumed that activity of the organization consists of identical repeated cycles, each divided into 3 phases.

1. Forming financial resources**.**

Financial resources of the organization are formed from two sources:

- external cash flow not connected with organization economic activity (investments, loans, profit withdrawals, credit payments, etc.);
- sales income generated by sales of the organization products produced in previous periods.

2. Payments not directly connected with production, forming of turnover funds**.**

Organization exercises financial payments not connected with the production volume (rent, wages, fixed payments to the budget, etc.), and pays taxes (income and turnover tax) calculated from the results of its activity in the previous period.

Remaining money resources are circulating assets of the organization, which will be used for production.

3. Production**.**

At step 3 the organization uses its circulating assets to produce goods, and the value of product unit is defined by variable costs of the organization.

Choosing the size of modelling cycle is very important, as practically each production is a process, so the cycle of the model is the decision of the modeler. The cycle size can influence the model in two ways:

- tax payments and covering fixed costs. These are exercised in each cycle of the model. So if too short cycle is chosen, e.g., one day, money to pay taxes, rent, wages, etc. will be withdrawn not at the end of the period, but daily. It is possible of course to calculate the corresponding share of costs (e.g. daily wages is equal to one thirtieth of the monthly wages) but it will lead to inaccuracy of modeling as manes used to pay taxes in the days one to before the last in any given month are not used for production. In this case it is necessary to consider the vector of fixed costs in which different elements will vary from one another (in elements corresponding to the last days of the month there will be no member responsible for wages payment, and in elements corresponding to other days of the month – no). Unfortunately, this method can not be used for taxes as their absolute value is not known a priori.
- Velocity of turnover. Absence of sales of products produced in the current period is an important condition of the model consistency. It means that if the step length is too big, money will be “frozen” as unfinished production. E.g. if production cycle is 5 days and step length is 10 days, the produce will be stored for 5 additional days before it will be sold, under the model.

In general, the choice of adequate step length is open for discussion. In case of absence of taxes, it seems logical to choose minimal step length and use fixed costs vector. In case taxes influence the economic activity considerably it is recommended to choose step length to minimize inaccuracies it can cause to the model.

Mathematical model description

Let us build equation for each phase of modelling the economic activity of the organization, using the fact that between the phases, the volume of money does not change, and all changes happen within the phases.

Phases 1- 2 are described by the equation

$$\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + F_t = VR_t + EC. \quad (1)$$

The right side of the equation are financial resources of the enterprise coming from the external cash flow F_t and sales from the previous periods $\sum_{i=1}^{m} Q_{t-i} \times P \times a_i$. Financial resources are spent to pay fixed costs EC and form circulating assets of the organization VR_t

If there are taxes equation 1 takes the following form

$$\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + F_t = VR_t + EC + q\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + r\sum_{i=1}^{m} Q_{t-i} \times P \times a_i - r(VR_{t-1} + EC). \quad (2)$$

There is a new member of the equation reflecting turnover tax $q\sum_{i=1}^{m} Q_{t-i} \times P \times a_i$ and income tax $r\sum_{i=1}^{m} Q_{t-i} \times P \times a_i - r(VR_{t-1} + EC)$. Income tax is calculated from the difference of expenditures at the previous step $VR_{t-1} + EC$ as sales at the current step $\sum_{i=1}^{m} Q_{t-i} \times P \times a_i$.

Phases 2-3 are described by the equation

$$VR_t = Q_t \times EV. \quad (3)$$

All circulating assets of the organization are used for production of Q_t units of goods with unit cost *EV*.

The final equation of the model is built by uniting equations 2 and 3

$$\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + F_t = Q_t \times EV + EC + q\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + r\sum_{i=1}^{m} Q_{t-i} \times P \times a_i - r(Q_{t-1} \times EV + EC.) \quad (4)$$

Thus the equation of the volume of production at step *t*

$$Q_t = \frac{(1-q-r)\sum_{i=1}^{m} Q_{t-i} \times P \times a_i + F_t - EC + r(Q_{t-1} \times EV + EC)}{EV}. \quad (5)$$

The main feature of model (5) is the possibility to follow the balance of products produced in each previous period.

Thus, unlike models requiring availability of a warehouse to store the balance of produce, this model the balance is exactly known for the previous and earlier periods. To use the additional advantages of the model (5) it is necessary to change the approach to forming reinvestment vector $a = (a_0, a_1, ..., a_m)$.

Reinvestment vector from the economic point of view is a lag with which money is returned to production. It is logical to understand this lag as the period of sale of the product. From this economic meaning of the vector $a = (a_0, a_1, ..., a_m)$, the following important features can be formulated.

1. non-negativity: $a_i \geq 0; i = \overline{0,m}$.

No vector elements are negative, as they characterize sales, if sales are at a loss, the organization can decide not to sell products, so this element of the vector equals zero.

2. norming at 1: $\sum_{i=0}^{m} a_i \leq 1$.

The sum of reinvestment vector elements can not be more than one as it is not possible to sell more products than were produced. When the sum of elements equal to 1 during *m* periods, all products are sold, when the sum is less than 1, only part of the produce is sold.

3. zero first element: $a_0 = 0$.

The first element of reinvestment vector should be equal to zero. Thus, we can not use autoregressive equations. This feature from the economic point of view means that products produced at the current step can not be sold at the same step.

Component a_i of reinvestment vector with index i characterizes the share of products produced *i* periods ago, which will be sold at this step.

Accounting of the balance of products is reasonable only when product features (the most important if demand for the product) depend on its age. This feature is characteristic first of all for food products and other perishable goods, or products which can be morally outdated very quickly.

Reinvestment vector is built according to the rule

$$a^*_i = \min(S_p \times a_i \times g_i, 1 - \sum_{j=1}^{j=i-1} a^*_j), \quad (6)$$

where $a = (a_1, a_2, ..., a_m)$ – vector defining the ability of the organization to sell the produce, $g = (g_1, g_2, ..., g_m)$ – vector defining dependence of product attractiveness for the customers on the product age, S_p – price attractiveness parameter characterizing the dependence of speed of sales on price: the higher the price, the lower S_p and vice versa.

Taking these additional parameters into account the basic model of organization (5) can be presented as

$$Q_t = \frac{1}{EV}((1-q-r)\sum_{i=1}^{m} Q_{t-i} \times P \times \min(S_p \times a_i \times g_i, 1 - \sum_{j=1}^{j=i-1} a^*_j) + \quad (7)$$
$$+ F_t - EC + r(Q_{t-1} \times EV + EC)).$$

One of the main disadvantages of the model described by equation 7, is the fact that with sufficient starting resources the volume of production grows exponentially. Too fast growth of production leads to reassessment of the effectiveness of using loans, as the optimal strategy is attracting maximum credits at any conditions.

To change the model in view of diminishing productivity of capital it is enough to introduce the parameter of the speed of diminishing productivity of capital EV_{inc}

$$Q_t = \frac{1}{EV} * (((1-q-r)\sum_{i=1}^{m} Q_{t-i} \times P \times \min(S_p \times a_i \times g_i, 1 - \sum_{j=1}^{j=i-1} a^*_j) + \quad (8)$$
$$+ F_t - EC + r(Q_{t-1} \times EV + EC))^{EV_{inc}}),$$

where EV_{inc} – variable describing the speed of costs growth. E.g. when $EV_{inc} = 1$ variable unit costs are not changed.

Model application and results analysis

The resulting model has the feature of diminishing production capital (in our case – of the circulating assets) and though the volume of production grows under unlimited increase of financial resources, the nature of this growth is difference (Figure 1).

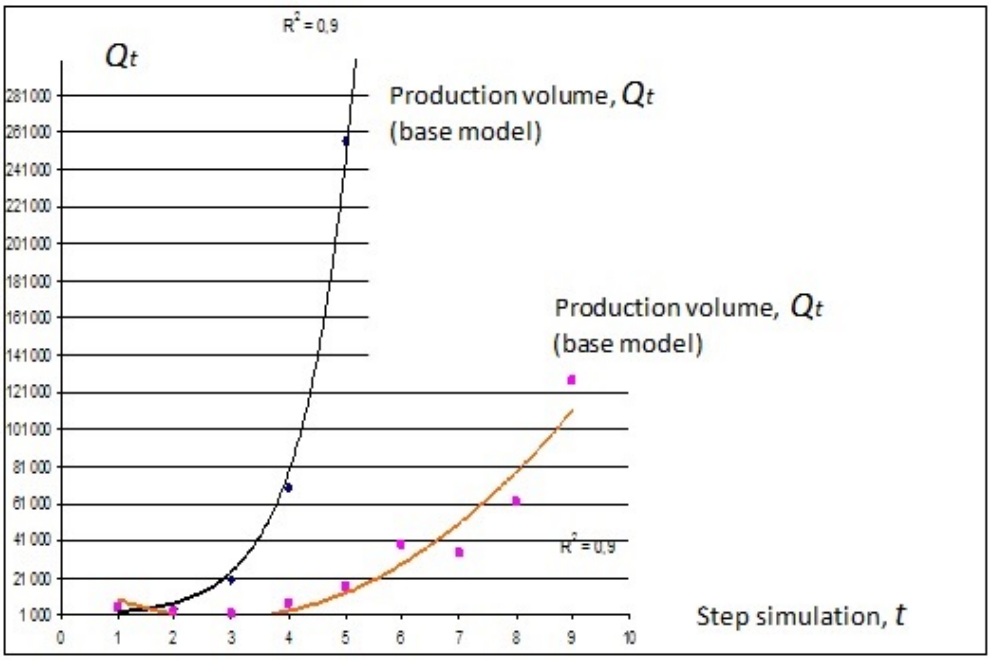

Fig.1. Volume of production over time for the resulting (8) and base model (7).

Let us undertake an imitation modelling of the organization economic activity using the model and the following variables: variable costs (EV = \$) at any moment of time t; fixed costs, (EC = \$ 1000) \$) at any moment of time t; product life time (m = 4); prices level (P = \$5); investments (F_t = \$10 000) at time t = 1, then F_t = 0, i.e. all money is invested at step 1); vector a = (0,6; 0,6;0,6;0,6) of sales speed; vector g = (1;0,5;0,1) customer attractiveness of the product; parameter S_p = 1 of price attractiveness; turnover tax q = 0,1; income tax r = 0,2, EV_{inc} = 0,91.

Figure 2 shows volumes of production relation to initial expenditures (investments F), F = 10 000; 20 000; 30 000; 40 000; 50 000; 60 000; 70 000.

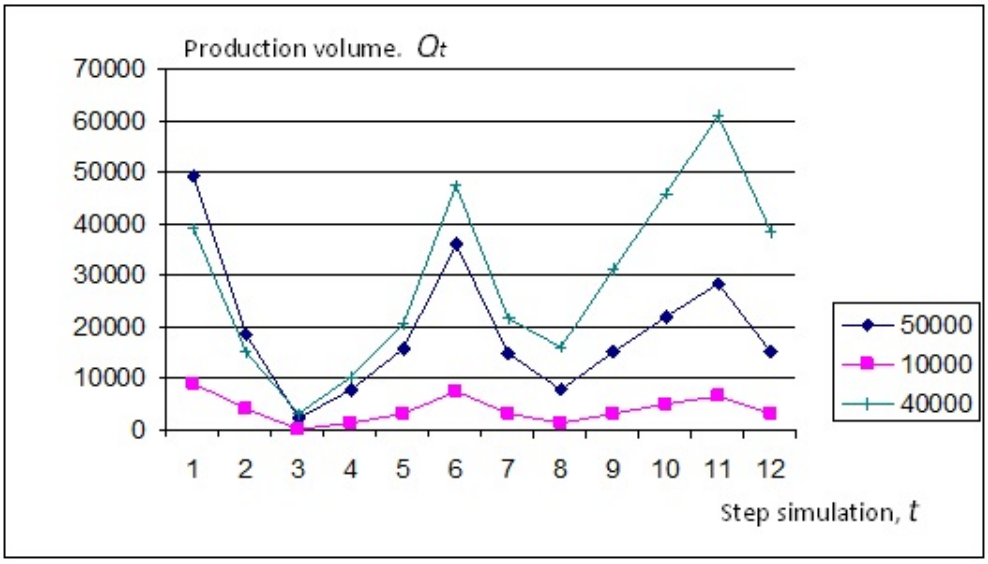

Fig.2. Influence of increasing expenditures (initial financial investments) on production output.

It is clear from Fig.2 that production output when $F = 50\,000$ is considerably lower than when $F = 40000$. Therefore, considerable increase of expenditures in the first step does not result in considerable increase of the production volume in the future.

Organization management using "costs-output" model (8) is done by changing the following parameters: external cash flow at step $t - F_t$ and unit price P.

It is possible to set the following management problems:

1. at what price and the fixed investments ($40 000) production output will reach 60 000 (units) in a year? (p = $6,10);
2. at what investments volume and the fixed price ($5, 00) production output will reach 1 000 000 (units) in a year? (F = $136 394,04).

Thus the "costs-output" model (9), based on regressive-autoregressive discrete equations has a wide field of application because it can be used for modelling organization behavior not only at the first stage of explosive growth but also for assessment of organization efficiency in the medium and long term perspective.

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METHODOLOGY AND INFORMATION TECHNOLOGY FOR THE QUANTITATIVE EVALUATION OF THE QUALITY PRODUCTS OF DISTILLERY AND WINE PRODUCTS

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The technique and information technology of the quantitative estimation of the products quality for alcoholic beverage and wine-making production is stated in the real work. The algorithm of functioning of computer expert system for vodka quality control, and also results of its use is given.

Keywords: technique, information technology, algorithm, expert system, quantitative estimation of quality, alcoholic beverage and wine-making production.

The technique of the quantitative estimation of the products quality for alcoholic beverage and wine-making production

Formalization of the concept "quality" of products of alcoholic beverage and wine-making production assumes the establishment of the unambiguous compliance between numerical values of set of the main tool and organoleptic indicators of concrete products of this production and some size which is integrally estimating their quality, for example, as a percentage.

Formalization of the concept "authenticity" of products of alcoholic beverage and wine-making production assumes the establishment of unambiguous compliance between numerical values of set of characteristic tool and organoleptic indicators of concrete products of this production and certain state standard samples.

In existing state standards, as well as in scientific and technical literature, integrated estimates of quality on set of the main tool and organoleptic indicators, and also an assessment of authenticity on set of characteristic tool and organoleptic indicators of products of alcoholic beverage and wine-making production are absent.

The technique and information technology of the quantitative estimation of quality of products of the alcoholic beverage and wine-making production, developed by chair of Information technologies of Moscow State University of Technologies and Managements (MSUTM) named K.G. Razumovsky is stated in the real work [1].

For descriptive reasons statements of a technique we will provide in the table 1 set of main indicators of vodka (from «Luxury» alcohol, with a strength of 56%), divided on three functional groups: safety (***X***), chemical and physical data (***Y***); organoleptic data (***Z***).

Table 1

The main indicators of vodka from the «Luxury» alcohol					
Indicators	**Name**	**Units measurements**	**Standard documentation**	**The bottom norm border**	**The top norm border**

Safety indicators (*X*)					
X_1	the lead	mg / Kg	SanPiN 2.3.2. 1078-01	0,000	0,300
X_2	the arsenic	mg / Kg	«—»	0,000	0,200
X_3	the cadmium	mg / Kg	«—»	0,000	0,030
X_4	the mercury	mg / Kg	«—»	0,000	0,005
X_5	the cuprum	mg / Kg	«—»	0,00	5,00
X_6	the zincSingular	mg / Kg	«—»	0,00	10,00
X_7	the caesium - 137	Becq / d^3	«—»	0,00	70,00
X_8	the strontium Singular -90	Becq / d^3	«—»	0,00	100,00
Indicators physical and chemical (*Y*)					
Y_1	the sugar	g/100 sm^3	State standard 13192-73	0,00	0,30
Y_2	alkalinity – the volume of hydrochloric acid of concentration of c(HCl) = 0,1 mol/dm^3, 100 cm^3 of vodka spent for titration	cm^3	State standard 5363-99	0,0	2,0
Y_3	acetic aldehyde in 1 dm^3 of waterless alcohol	mg / d^3	State standard P 51698	0,0	3,0
Y_4	fusel oils (2-propanol, 1-propanol, 1-butanol, isobutyl alcohol, izoamilovy alcohol) in 1 dm^3 of waterless alcohol	mg / d^3	«—»	0,0	6,0
Y_5	esters (methyl acetate, ethyl acetate) in 1 dm^3 of waterless alcohol	mg / d^3	«—»	0,0	5,0
Y_6	the methyl alcohol in terms of waterless alcohol	% ,vol	«—»	0,00	0,02
Y_7	acids (acetic, oil and so forth)	mg /100 cm^3	State standard P 51135	0,0	400,000

Y_8	pH	—		6,2	8,5
Y_9	SO_4^{2-}	mg /dm^3	PTR 10-12371-99	0,0	20,0
Y_{10}	Cl^-	mg /dm^3	«—»	0,0	30,0
Y_{11}	Si^{4+}	mg /dm^3	«—»	0,0	15,0
Y_{12}	Fe	mg /dm^3	State standard 13195-73	0,00	15,00
Y_{13}	the transparency	% $T_{BF364}^{l=50}$		100,0	100,0
Indicators organoleptic (*Z*)					
Z_1	the appearance (transparency and color)	points	State standard P 51355	1,5	2,0
Z_2	the aroma	points	«—»	2,5	4,0
Z_3	the taste	points	«—»	2,5	4,0
Z_4	the total mark assessment	points	«—»	6,5	10,0

We will notice that to a condition of norm (in accordance with state standard) there correspond those indicators ($X_1, X_2, \ldots, X_L$); ($Y_1, Y_2, \ldots, Y_P$); ($Z_1, Z_2, \ldots, Z_Q$) which components satisfy to some restrictions $F_n^* \le F_n \le F_n^{**}$; $n = 1, 2, \ldots, N = L + P + Q$ which have been set by limit bottom F_n^* and top F_n^{**} values ($L = 8$, $P = 13$, $Q = 3$).

The bottom limits F_n^* can accept zero values that is characteristic practically for all indicators of safety and a number of physical and chemical indicators of vodka and wine. For a number of indicators of vodka and wine $F_n^* \neq 0$ (for example, the fortress or a volume fraction of ethanol, mass concentration of sugars, mass concentration of titrable acids, mass concentration of iron for wine).

It should be noted also that when using the gas hromatografic methods for wine it is possible to define additional indicators (for example, mass concentration of lemon, apple, dairy, amber, acetic acids, sucrose, glucose, fructose), for which $F_n^* = 0$, and also mass concentration of wine acid with $F_n^* \neq 0$..

At its standardization, apparently, it is expedient to set the standard of the given extract average value.

In the considered situation we will consider that 100% quality of a product on each group of tool indicators (***X*** и ***Y***) of the table 1 it has to be reached at the full coincidence of their F_n values to some "reference" F_{nm} values ($F_n^* \le F_{nm} \le F_n^{**}$), где $n = 1, 2, \ldots, N$; $m = 1, 2, \ldots, M$.

It is quite obvious that 100% quality of a product on group of organoleptic indicators (***Z***) of the table 1 are reached at the full coincidence of their Z_n values to upper bounds of estimates Z_n^{**}, i.e. $F_{nm} = Z_{nm}^{**}$.

We will consider also that at F_n the deviation from F_{nm} the value of the criterion of an indicator of quality has to decrease.

For the quantitative estimation of differential criteria of quality (on separate indicators of ***X***, ***Y***, ***Z***) we will use the following indistinct measures of similarity [2]

$$\mu_1(\boldsymbol{F},\boldsymbol{F}_m)=\frac{1}{1+\sum_{n=1}\frac{\alpha^2_{n\boldsymbol{F}}(F_n-F_{nm})^2}{h^2_{n\boldsymbol{F}}}},$$

$$\mu_2(\boldsymbol{F},\boldsymbol{F}_m)=\exp\left[-\sum_{n=1}\frac{\alpha^2_{n\boldsymbol{F}}(F_n-F_{nm})^2}{h^2_{n\boldsymbol{F}}}\right], \quad (1)$$

where $\alpha_{n\boldsymbol{F}}=(\alpha_{n\boldsymbol{X}},\alpha_{n\boldsymbol{Y}},\alpha_{n\boldsymbol{Z}})$ – a vector of weight coefficients, indicators defining to the importance in each group ($\boldsymbol{X}$, $\boldsymbol{Y}$, $\boldsymbol{Z}$) ; $h^2_{n\boldsymbol{F}}$ – some estimates of unknown hindrance's intensities (n = 1, 2, …, $N = L + P + Q$).

As estimates of unknown hindrance's intensities, estimates received from expression can be used

$$h^2 = s^2 + \Delta^2, \quad (2)$$

where s – the standard deviation determined by a tool error of measurement of an indicator of object; Δ - the dispersion or the range of possible values of indicators, defined by technological conditions of "preparation" of a product.

The reference of observed unknown group vectors of $\boldsymbol{X}$, $\boldsymbol{Y}$ and $\boldsymbol{Z}$ states to one of the M "reference" vectors (or group of "reference" vectors) $\boldsymbol{X}_m$, $\boldsymbol{Y}_m$ and $\boldsymbol{Z}_m$ can be carried out by comparison of all the statistician of μ from (1) with each other and a choice of such $\boldsymbol{X}_m$, $\boldsymbol{Y}_m$ and $\boldsymbol{Z}_m$ (or groups of "reference" vectors) for which statisticians of μ from (1) will accept maximum values.

For an assessment of integrated criterion of quality of alcoholic beverage and wine-making production we will define the final expression, using coefficients ($\beta_{\boldsymbol{X}}$, $\beta_{\boldsymbol{Y}}$, $\beta_{\boldsymbol{Z}}$), verifying group importancies $\beta_{\boldsymbol{X}}+\beta_{\boldsymbol{Y}}+\beta_{\boldsymbol{Z}}$=1), and the operation of algebraic association of fuzzy sets [2]

$$\mu_{\Sigma}(\boldsymbol{F},\boldsymbol{F}_m)=\left[\begin{array}{l}\beta_{\boldsymbol{X}}\mu(\boldsymbol{X},\boldsymbol{X}_m)+\beta_{\boldsymbol{Y}}\mu(\boldsymbol{Y},\boldsymbol{Y}_m)+\beta_{\boldsymbol{Z}}\mu(\boldsymbol{Z},\boldsymbol{Z}_m)- \\ -\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Y}}\mu(\boldsymbol{X},\boldsymbol{X}_m)\mu(\boldsymbol{Y},\boldsymbol{Y}_m)-\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Z}}\mu(\boldsymbol{X},\boldsymbol{X}_m)\mu(\boldsymbol{Z},\boldsymbol{Z}_m)- \\ -\beta_{\boldsymbol{Y}}\beta_{\boldsymbol{Z}}\mu(\boldsymbol{Y},\boldsymbol{Y}_m)\mu(\boldsymbol{Z},\boldsymbol{Z}_m)+ \\ +\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Y}}\beta_{\boldsymbol{Z}}\mu(\boldsymbol{X},\boldsymbol{X}_m)\mu(\boldsymbol{Y},\boldsymbol{Y}_m)\mu(\boldsymbol{Z},\boldsymbol{Z}_m)\end{array}\right] / \quad (3)$$
$$/\left(1-\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Y}}-\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Z}}-\beta_{\boldsymbol{Y}}\beta_{\boldsymbol{Z}}+\beta_{\boldsymbol{X}}\beta_{\boldsymbol{Y}}\beta_{\boldsymbol{Z}}\right)$$

It is obvious that the decision on authenticity of a concrete product of alcoholic beverage or wine-making production can be accepted on the basis of the comparison of integrated criterion of quality of $\mu_{\Sigma}(\boldsymbol{F}, \boldsymbol{F}_m)$ with some threshold of T_{Σ} which value can be found empirically.

The information technology of the products quality estimation for alcoholic beverage and wine-making production

The developed technique was applied to the estimation of criteria of quality of some samples of the best domestic and foreign vodka (fortress of 40%) according to remarkable, in our opinion, works [3].

The qualimetrical computer expert system functioning on algorithm described above was created for these purposes [4].

Thus, the importance of all indicators were chosen equal ($\alpha_{nX} = \alpha_{nY} = 0{,}1; \alpha_{nZ} = 0{,}3$). As "reference" zero values of indicators of $F_{n\text{Э}} = 0$, behind an exception were chosen: $Y_{8\text{Э}} = 7{,}0$ (pH); $Y_{13\text{Э}} = 100$ (transparency); $Z_{4\text{Э}} = 10$ (total mark score). For reference value of oxidability according to Lang was obtained 30 min. The dispersion or the range of possible Δ values for each indicator was estimated by its selective standard deviation (on the group of indicators given in [3]).

For descriptive reasons in the form of inquiry «Putinka» vodka indicators were entered to expert system.

The result of the computer expert system work is given in the table 2. Places are shown in the table taken by vodka according to the integrated criterion of quality at various importancies of groups of indicators (safety, physical and chemical, organoleptic).

The variation of group importancies in the wide range showed high qualities of «Russian Brillian»t and «Russian Standard» vodka and stability of the criterion of quality. At the same time, among vodka given in [8]: on the group of indicators of the safety the vodka «Russian Standard» is the leader, on the group of indicators of physical and chemical the vodka «Skyy» (USA) is the leader, on the group of indicators organoleptic the vodka «The Russian brilliant» is the leader.

At increase of the importance of the group of organoleptic indicators by the leader there is a «Putinka» vodka that is connected with the highest estimation (9,6 mark) of the organoleptic indicator among given vodka.

The minimum value of integrated criterion of quality was equal in all cases of 72%.

Thus, results of quantitative researches completely coincided with qualitative conclusions [3] that confirms efficiency of the developed technique.

Conclusions

The offered technique and the information technology of the construction of qualimetrical computer expert systems realized on its base for the first time allow to carry out the joint quantitative accounting of the all set of indicators of quality of the alcoholic beverage and wine-making production, defined by tool and organoleptic methods to compliance with operating state standards.

Created the technique and the information technology also allow to solve problems of estimation of admissible price ranges of the products connected with their quality [5].

In more detail models of the quantitative estimation of the quality of foodstuff are given in [6].

Further improvement of the technique given above is connected with the addition to three considered two more functional groups caused by initial raw materials, – indicators of water and alcohol indicators, and also specification of impotencies α_{nF} all indicators and their "reference" values.

In the conclusion authors express gratitude to I.M Abramova for the big help in the work.

Table 2

Results of the comparative analysis of vodka on the integrated criterion of the quality											
The group impotencies variation											
The group of safety	β_X	1,000	0,000	0,000	0,500	0,000	0,333	0,167	0,500	0,250	0,167
The group of physical and chemical	β_Y	0,000	1,000	0,000	0,000	0,500	0,333	0,333	0,333	0,250	0,167
The group of organoleptic	β_Z	0,000	0,000	1,000	0,500	0,500	0,333	0,500	0,167	0,500	0,667
The product name:		Places determined by the integrated criterion $\mu_\Sigma(F, F_m)$									
«Grey Goose» (France)		9	8	6	9	8	9	8	9	8	7
«Belvedere» (Poland)		8	4	8	8	7	7	7	7	7	8
«Ketel One» (Holland)		7	9	8	7	9	8	9	8	9	9
«Skyy» (USA)		6	1	7	6	6	6	6	6	6	6
«Tanqueray Sterling» (Great Britain)		4	7	3	4	5	5	5	4	5	4
«The Russian brilliant» (Russia)		3	3	2	1	1	1	1	1	1	2
«Russian Standard» (Russia)		1	5	4	2	4	3	3	3	3	3
«White gold» (Russia)		2	2	5	3	3	2	4	2	4	5
«Putinka» (Russia)		5	6	1	5	2	4	2	5	2	1

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THE LABORATORY STAND FOR DIAGNOSING OF RADIO-ELECTRONIC EQUIPMENT ON THE EXAMPLE OF THE COMMON EMITTER AMPLIFIER

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The article suggests and describes a laboratory stand, allowing analysis printed board assembly electronic equipment (low-frequency amplifier) with the aim of monitoring the technical condition and diagnosis. This method has been implemented stand "Troubleshooting Handbook." The stand is designed for laboratory work by students in the course "means and methods of technical diagnostics."

Laboratory stand on the basis low-frequency amplifier is a PCA (Fig. 1), placed in an enclosed housing.

Fig.1. PCA on the basis of low-frequency amplifier

With the purpose supply of test signal and the feedback circuit analysis provides external pins. Electrical circuit printed board assembly is presented in Figure 2.

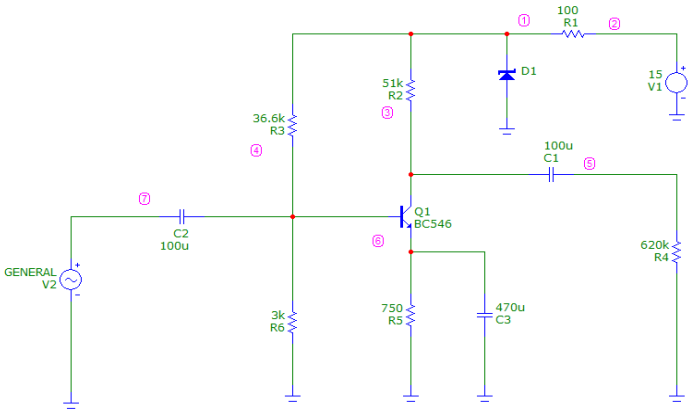

Fig.2. Electrical circuit printed board assembly

It was developed on the basis of of the amplifier stage with a common emitter. Operates in the frequency range from 4 Hz to 23 kHz, with a gain of 87 to 100 times.

Modeling circuitry carried in the software package MicroCap, where they were picked the optimal internal parameters of components for the functioning of the scheme. In MicroCap not always present domestic items, so the transistor and zener were selected among the import, BC546 and D814A, respectively.

In order to prevent voltage drop, voltage regulator circuit is added. Stabilization is carried out at 8 V.

A distinctive feature of the laboratory stand is the embedded microcontroller. It is designed for reading of potentials from printed board assembly control points to monitor circuit operation in real time at each of its node. This allows make PCA more visible for diagnosis.

Laboratory stand intended to diagnose electronic means by artificial introduction of faults in the circuit (open circuit, short circuit, etc.) and removing voltages from checkpoints. As well as transmitting the data to a computer using a microcontroller, where they were treated and a diagnosis - the cause of failure of a circuit element, if any.

All work includes 7 stages:

- The first stage includes circuit simulation systems : MicroCap, DiaEl, Layot.
- The second stage - production PCA modeled circuitry in step number 1.
- The third step involves modeling the casing sizes in the software package SolidWorks, taking into account the size of the scheme , which is taken from the program Layout.
- In the fourth stage being developed all the inputs and outputs of the stand , as must be provided to all the terminals of the stand (USB, LAN port, under the oscilloscope , etc.) , as well as ease of switching , transport stand , on / off toggle switches , etc.
- In the fifth stage, the production the stand, taking into account all the dimensions measured and modeled in stages 1 and number 3 number.
- The sixth stage involves the development of a program module ASONIKA-D using the software package Microsoft Visual Studio in order to carry out automatic calculations scheme, and also to see clearly not only real stand out, but its prototype on a computer screen.
- The seventh stage is the final and includes a test lab for the purpose of testing.

In order to stand was mobile , i.e. it can be transferred to any audience and work with him in any classroom display , considered the requirements for minimizing the number of control points to reduce the size of the stand. And also feature takes stand when you can work with him at a distance using a mobile phone platform Android (version 2.3 and above) or a PC emulator .

The whole essence of the work lies in the fact that making a fault in the circuit (fault makes the teacher : " Mode 1 ", " Mode 2 ", etc.) , the student should he find out what does not work in the scheme properly, seeing its virtual model on your computer. Furthermore, conducting the necessary calculations to the program diagnosis (fault , break , etc.) and that , in turn compares the student's answer and the " response" scheme to artificially influence.

The introduction of the stand in the learning process will increase the efficiency of absorption of disciplines "Quality Management" and " Methods and technical diagnostic means ."

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COMPUTER-AIDED DESIGN OF HYBRID QUANTUM-CLASSICAL INTEGRATIONS

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The goal of this paper is to analyze the current state of the developments of software tools for simulation and design of the next-generation electronics integrating the quantum-based components and classical electronic circuits. The main attention is paid to the representation of the Schrödinger equations by their equivalent circuit ones and simulations of them by available fast SPICE-based circuit modelling tools to provide seamless modelling of hybrid quantum-classical integration.

Keywords: Schrödinger equations, CAD, nanoelectronics, quantum integration

1. Introduction

The key tendency of contemporary electronics is the reduction of the component size down to several nanometers or even to the molecular size with the exploitation of quantum phenomena as the main effects in these elements [1]-[4]. There are many challenges in this area including those which are in their theory, technology, and compatibility of them with the classically designed electronic integration.

Additionally to the solution of these problems, industry needs the well-developed, verified, and fast mathematical models of new components for low-cost computer aided design (CAD). Taking into account that the creation of completely new CAD tools is a very time- and cost-consuming task, there is strong demand to adopt the modelling ideology of quantum-based components to the already existed CAD environment [5]. Ignoring these industry needs leads to increased cost of new electronics or to complete fail of exploitation of many interesting nano-technological achievements.

Unfortunately, there are many challenges to provide electronics by adequate numerical tools of this kind which are applicable for industrial simulation and design. Several known research and commercial codes aim at the simulation of particular effects or particular quantum-based devices. Some industrial codes have been already adapted to the exploited manufacturing technology, but they are not able to be used elsewhere outside.

A universal research software tool for atomistic simulation of 3-D nano-components is under the developments in Purdue University (USA) [6]. It exploits the many-particle methods, semi-classical Schrödinger-Poisson algorithm, non-equilibrium Green's function approach, etc. For simulation of millions of atoms in a nano-domain, it requires from 10^3 to 10^7 processors of one of the USA's peta-scale supercomputers, and it shows acceptable accuracy in the modelling of some quantum phenomena and simple nano-components.

As it is seen, a large research and programming work still should be performed to create the industry-oriented tools for quantum-mechanical or semi-classical simulations of integrated nano-components. Meanwhile, this work has strategic meaning, and it will define the future of electronics.

2. Seamless Simulation of Quantum-classical Electronics and the Available Theory

As it has been mentioned, the development of new software tools for new-age of electronics is a very time- and resource-consuming task. Instead, the quantum-mechanical models of new components should be adapted to the already existed CAD tools with their well-developed instrumentation, as it was proposed in [5]. The modern CAD tools are based on the SPICE algorithm or its modifications. Some of them are for simulations of gigascale integrations, where the number generic circuits may be around $50 \cdot 10^6$, i.e. the computational power of these advanced circuit simulators and today's computers is pertinent for the atomistic calculations. Then, the models of quantum-mechanical and nano-elements should be adapted to these simulators and these components should be represented by their equivalent semi-empirical circuits which are obtained analytically from the quantum-mechanical or semi-classical studies or using measurement data. These elements are to compose the component library similarly to the classical CAD tools.

Unfortunately, in nano- and quantum-based electronics, the list of possible elements is rather far to be completed. In fact, the number of prospective elements is growing very fast. Analytical treatment of all of these elements using the semi-classical or quantum-mechanical theories is difficult or impossible, although it is interesting from the scientific and practical point of view [7]. Then, the software tool of future should have the means of direct simulation of quantum-mechanical equations for these components. These equations, as it has been known from the works of G. Kron and other authors [8]-[13], can be represented by the circuit ones regarding to the equivalent quantum currents and voltages, and then, they can be simulated numerically by the circuit simulators based on fast SPICE algorithms.

Consider, for instance, the linear Schrödinger equation valid in the volume V :

$$-\frac{\hbar^2}{2m}\nabla^2\psi(\mathbf{r},t)+U(\mathbf{r})\psi(\mathbf{r},t)=j\hbar\frac{\partial}{\partial t}\psi(\mathbf{r},t) \tag{1}$$

where ψ is the wave-function, U is the potential, m is the particle mass, and $\hbar$ is the normalized Planck's constant. It is is represented by its equivalent 1st -order partial differential ones:

$$\begin{aligned}\nabla u(\mathbf{r},t)&=-j\frac{m}{\hbar}\mathbf{i}(\mathbf{r},t),\\ \nabla\mathbf{i}(\mathbf{r},t)&=\frac{2\partial u(\mathbf{r},t)}{\partial t}+\frac{2j}{\hbar}U(\mathbf{r})u(\mathbf{r},t)\end{aligned} \tag{2}$$

where

$$u(\mathbf{r},t)=\psi(\mathbf{r},t),\text{–"voltage"},\ \mathbf{i}(\mathbf{r},t)=j\frac{\hbar}{m}\nabla u(\mathbf{r},t)\text{–"current"}. \tag{3}$$

The equs. (2) are expressing the Kirchhoff law written in its differential form, and they are represented at any space point by an equivalent circuit for a small volume $\Delta x\Delta y\Delta z$. The whole domain V is covered by these circuits jointed to each other. This volume circuit with the boundary elements and initial conditions is the one to be simulated using a circuit simulator.

Unfortunately, for quantum-mechanical problems, the number of these elementary circuits can be very large, reaching millions, and these finite-difference equations used here should be transformed into the ones of decreased number, and the fast algorithms of their calculations should be used, including the iteration schemes and parallel computations. For instance, using a method of *macromodelling* developed in the MIEM [14] allows to decrease the calculation time and required memory down to 100-1000 times, and it will make the quantum-mechanical problem being calculated by powerful PC, workstations or multi-core

multi-thread processors, but not only using supercomputers. Then, it makes realistic to simulate the 3-D Schrödinger equations in its effective-mass approximation defined in domains of the size less than 10-20 nm with the industry-friendly circuit software tools.

The method of the effective mass, which will be used initially, has some limitations in its accuracy, and the self-consistent methods for calculation of the electron transport problem should be used. Typically, in this case, the non-linear system of the Schrödinger and Poisson equations is simulated, and its multi-step solution is very time-consuming. Besides, these equations are not applicable for Tera- and optical frequencies, where the large and complicated system of the coupled Maxwell and Schrödinger equations must be used. For this case, a compact electromagnetic (EM)-quantum equation was proposed in [12],[13] for single electron using the Hertz vector of the EM field

$$j\hbar\frac{\partial\psi}{\partial t}=-\frac{\hbar^2}{2m}\nabla^2\psi-\frac{j\hbar q}{mc^2}\frac{\partial\boldsymbol{\Gamma}_e}{\partial t}\left(\nabla\psi\right)+\left\{\frac{q}{2mc^2}\left[q\left|\frac{\partial\boldsymbol{\Gamma}_e}{\partial t}\right|^2-j\hbar\left(\nabla\frac{\partial\boldsymbol{\Gamma}_e}{\partial t}\right)\right]-q\nabla\boldsymbol{\Gamma}_e\right\}\psi \quad (4)$$

where q is charge with the mass m, and c is light velocity,

$\boldsymbol{\Gamma}_e=\int_{V'}d\mathbf{r}'\frac{\mathbf{p}_e\left(t+\frac{|\mathbf{r}-\mathbf{r}'|}{c},\mathbf{r}'\right)}{4\pi\varepsilon_0\left(\mathbf{r}-\mathbf{r}'\right)}$ is the electric Hertz vector with $\mathbf{p}_e=const+\int_0^t\mathbf{J}_e\left(t',\mathbf{r}\right)dt'$,

and $\mathbf{J}_e=\left(\frac{\hbar q\left(\psi^*\nabla\psi-\psi\nabla\psi^*\right)}{2jm}-\frac{q^2|\psi|^2}{c^2m}\frac{\partial\boldsymbol{\Gamma}_e}{\partial t}\right)$.

The equ. (4) substitutes the Maxwell /Schrödinger system of equations, and it is easy to be calculated using the perturbation approach when the linear part is solved by the above-mentioned fast circuit simulator, and the nonlinear solution is obtained analytically using a known algorithm. It will make realistic the calculations of the EM/quantum equations using the powerful workstations instead of supercomputers. In addition to the Schrödinger /Maxwell equations, the use of the Hertz vectors allowed to obtain the compact Pauli, Dirac, and Klein-Gordon/ Maxwell equations [12].

For a few-(N) electron system moving through solids, the above-considered theories may fail due to strong interactions of the carriers of electricity and discrete nature of these interactions. Here, the effective average potential or the Hartree potential approach will be studied for the goal to enhance the software tool area of applications:

$$\left[-\frac{\hbar^2}{2m}\nabla_i^2+U\left(\mathbf{r}_i\right)+\frac{q^2}{4\pi\varepsilon_0}\sum_{j=1(j\neq i)}^{N}\int d\mathbf{r}_j\frac{\left|\psi_{\nu_j}\left(\mathbf{r}_j\right)\right|^2}{\left|r_j-r_i\right|}\right]\psi_{\nu i}\left(\mathbf{r}_i\right)=\varepsilon_i\psi_{\nu_i}\left(\mathbf{r}_i\right) \quad (5)$$

where this equation is written for the i-th electron (its energy eigenstate ε_i) interacting with j-th one. The total wave-function in this case is a product of all i-th ones. It is possible to decrease the complexity of these computations estimating the level of interactions of electrons with each other and taking into account only the strongest ones.

3. Current State of the Developments of Circuit-based Quantum-classical Simulator

To this time, the circuit approach was verified by us using several circuit simulators, including the Agilent Advanced Design System (ADS). In addition to the linear Schrödinger equation for elementary finite-size barrier problem for which the exact solution is known [11], the nonlinear time-dependent Schrödinger equations are solved in [13], and the introduced

circuit techniques were verified comparing our results and the published experimental and simulation data.

Fig. 1 shows an example of the Schematic window of the Agilent ADS with an equivalent circuit drawn for the 1-D limited-width barrier problem to test the circuit simulations.

Additionally to the circuit-based numerical simulations and techniques [5],[11]-[13],[15], a new effective algorithm was written and applied for 3-D simulation of wave-functions of

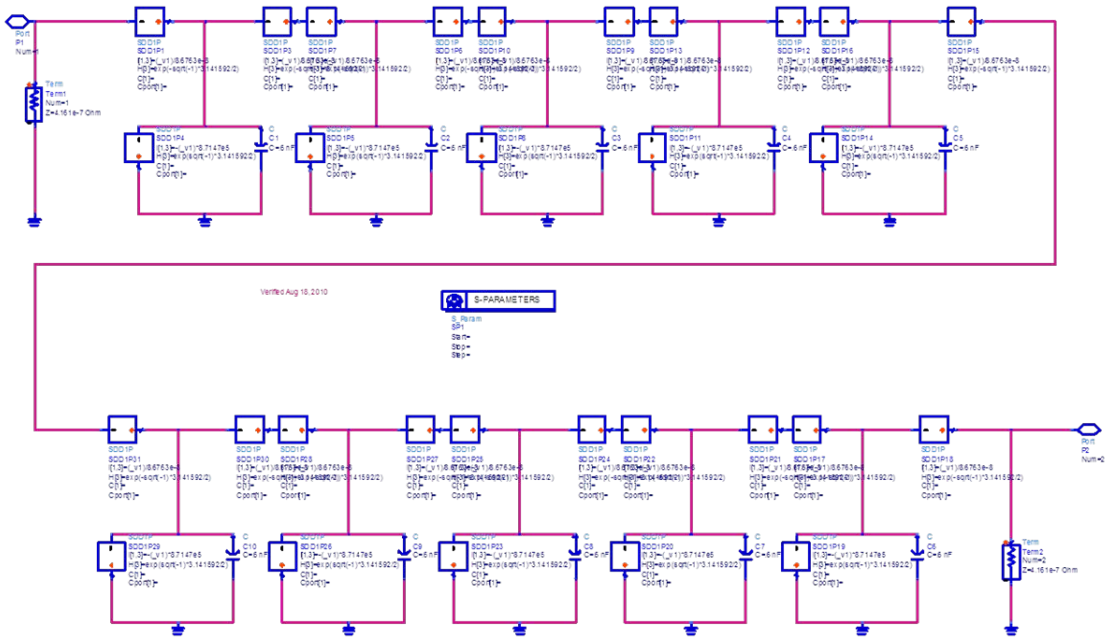

Fig. 1. Schematic window of the Agilent ADS with an equivalent circuit drawn for the 1-D limited-width barrier problem.

single bosonic atoms trapped in random potentials in [16] which can be a part of future universal simulator. Some semi-empirical circuit models of Josephson-effect based components have been developed for the library of discrete components of this circuit simulator for hybrid quantum-classical electronics [17]. Near-future work is with the creation of a full-functional prototype of the software for seamless simulation of quantum-classical integration.

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MATHEMATICAL MODELING OF VIBRODIAGNOSTICS LATENT DEFECTS IN THE CONSTRUCTION OF ELECTRONIC MEANS

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The possibilities of computer simulation of mechanical defects designs electronic equipment were explored, among SolidWorksSimulation. A comparative analysis of the results of computer simulation and the experimental results were hold.

Keywords: diagnostics, computer modeling, latent defects.

Onboard wireless devices in service are subject to constant mechanical stress. The most common of them are single harmonic vibrations and shocks. To meet the requirements on reliability, all equipment placed in a sealed unit. To detect latent defects in such devices was developed a method of nondestructive testing [1].

Proposed in [1] method is based on the analysis of changes in the amplitude-frequency characteristics taken from the vibration sensor signal (Fig. 1), which is integrated at PCA (printed-circuit assembly). Amplitude of the signal changes during frequency change applied harmonic signal on PC using vibroemulator.

Shock sensor and vibroemulyator set on PCB during assembly PCA, which allows to produce output control of manufactured unit on completion, and in service to diagnose remotely equipment for mechanical defects.

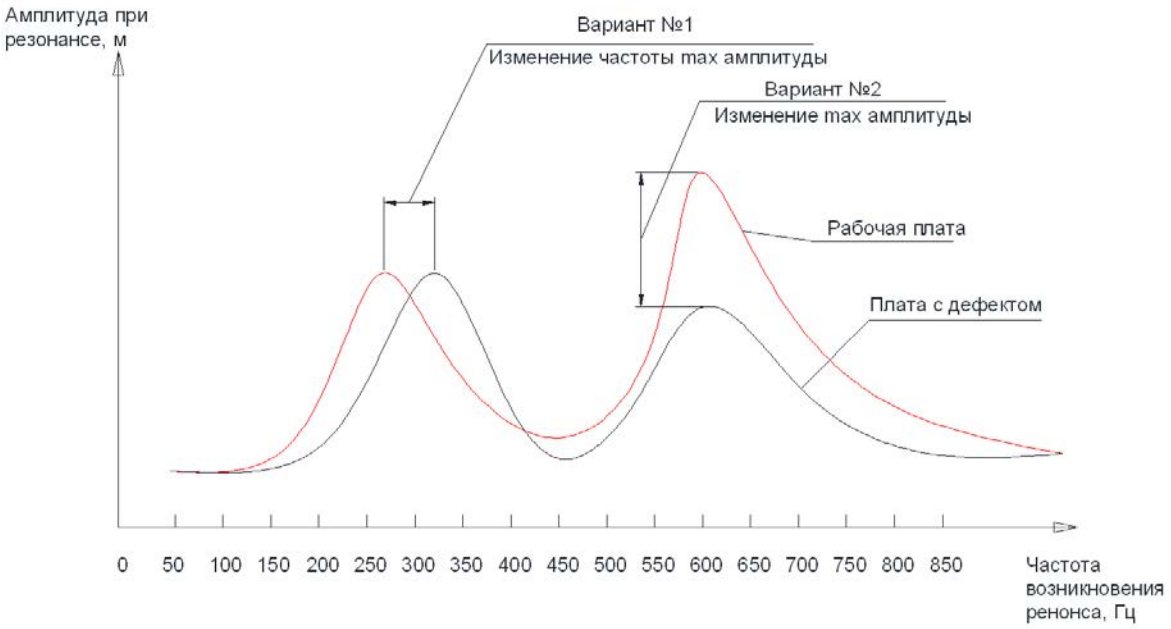


Figure 1 Changes in the frequency response.

For experimental validation of the method designed printing unit (PU), on which are placed two operational amplifiers. This IP is integrated into the navigation unit positioning (Figure 2.) to amplify the signal from the vibration sensor and vibroemulyator.

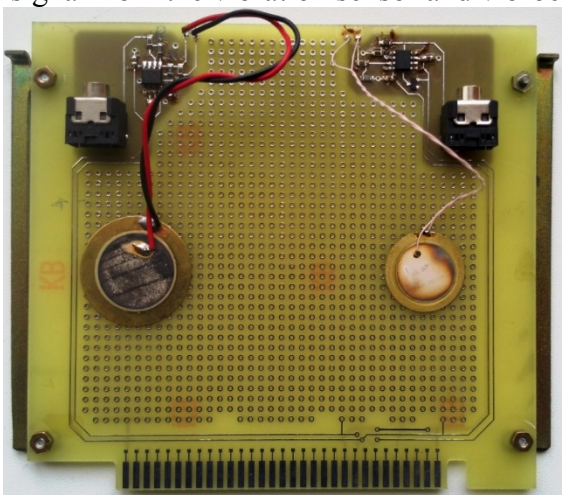
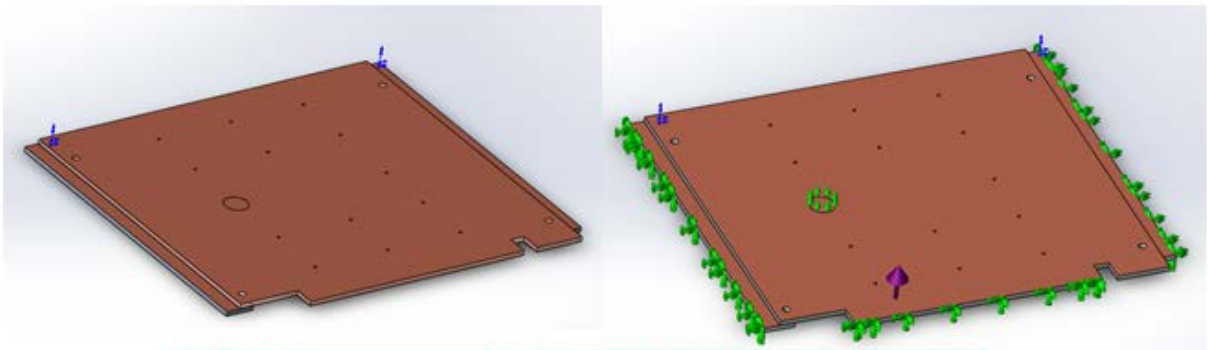


Figure 2 PCA.

Experimental studies require considerable time for amplitude-frequency characteristics for different types of defects. The only way to solve this shortcoming is to simulate mechanical processes PCA using CAD packages. Computer simulation as accurately as possible repeats the printhead parameters.

The simulation was performed in a medium SolidWorksSimulation. Simulated circuit board size 124 * 106 mm. The material the board was made (FR-4), is the most common in the world of the basic materials for the production of double-sided and multilayer printed circuit boards with high requirements for mechanical strength.



Свойства	Стеклотекстолит	Медь
Коэффициент Пуассона, Н/м2	0.17e9	1.1e11
Модуль Юнга	0.3	0.37
Плотность, кг/м3	1250	8900

Figure 3. PCA model in a medium SolidWorksSimulation

The software allows you to estimate the response of the model by adding the impact of each mode on the medium load. In most cases, only the lower modes contribute significantly to the reaction. Influence of mode dependent on the frequency spectrum of the load magnitude, direction, duration and location.

The equation of motion to be solved by systems with many degrees of freedom, is given by [4]:

[M} (U" (t)) + [C] ∗ (U (t)) + [K](U(t)) = (f(t))

Where [M] - mass matrix

[K] - stiffness matrix

[C] - damping matrix

U (t) - time during movement vector

U (t) - time of the velocity vector

U "(t) - the acceleration vector in time

f (t) - the time-varying load vector

In simulation in the software package wondered physical properties of the model: the Poisson's ratio, Young's modulus, density materials, the damping coefficient. For the model boundary conditions were set: no movement and rotation angles on the surface of the walls, bolt, holes, which carries mounting board to the housing unit. PU applied to the disturbance in the required area of the model represented harmonic oscillations with a given amplitude and frequency. Perturbation effects applied to PU in the required area of the model represented harmonic oscillations with a given amplitude and frequency.

The results of simulation of mechanical processes PCA are amplitude-frequency characteristics.

On the figure 4 the comparison with experimental study of the frequency response is shown.

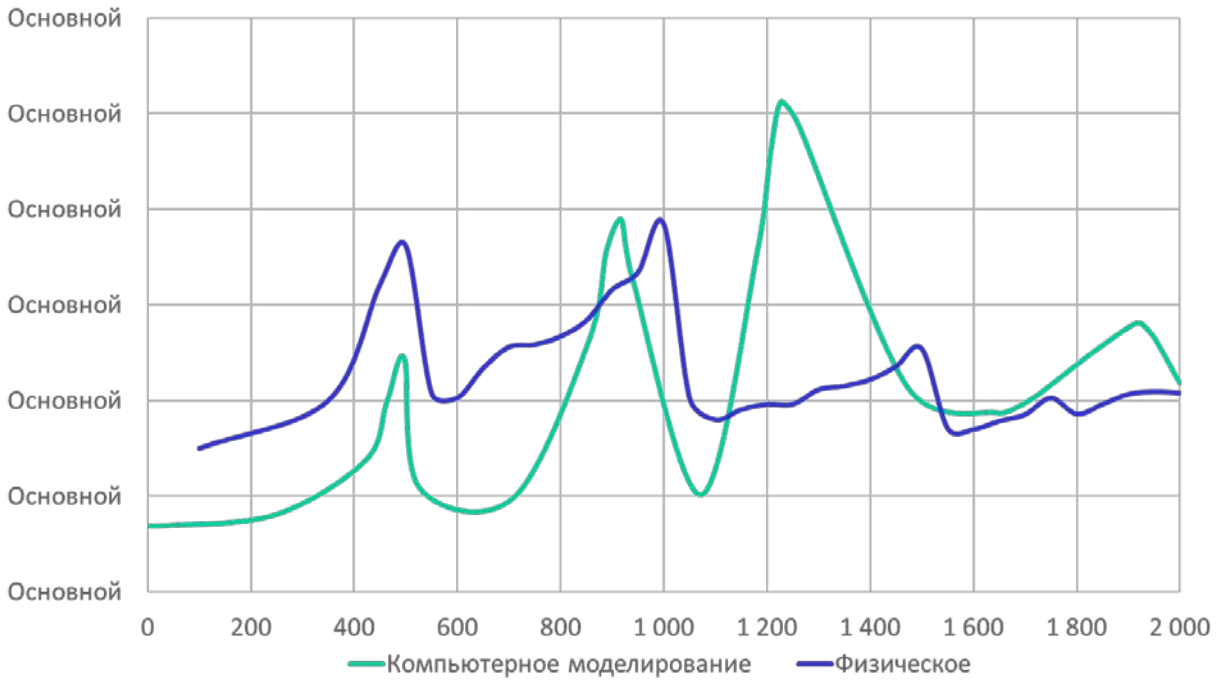


Figure 4 Comparison of the frequency response simulation and experiment.

In general we can say satisfactory convergence results. Thus, in the first place it should be noted almost complete match the resonant frequency of the first peak in the vicinity of 500 Hz. In the future, there is a gradual, progressive divergence graphs, which may be due to the imperfection of physical modeling techniques. Overall, however, the general character of the schedules is the same.

Providence studies show high prospectivity of the proposed method.

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Section 4
INNOVATIVE INFORMATION TECHNOLOGY IN SOCIAL-ECONOMIC SPHERE

APPLICATION OF SELF-ORGANIZATION APPROACH FOR SOLVING THE PROBLEM OF FORECASTING IN AN INTELLIGENT MANAGEMENT SYSTEM OF INNOVATIVE DEVELOPMENT OF THE RUSSIAN MEDICAL-INDUSTRIAL COMPLEX IN THE INFORMATION SOCIETY

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The possibilities and prospects of applying self-organization approach for solving the problem of forecasting in an intelligent management system of innovative development of the Russian MIC in the information society are discussed. MIC information and analytical website could be the basis for the creation of the intelligent management system of innovative development of MIC. Members of a valeological Internet community forming around MIC website will act as experts in the intelligent management system of innovative development of MIC.

Keywords: health care modernization, innovative development, information society, Russian medical-industrial complex, information and communication medical-industrial space, MIC information and analytical website, intelligent management system, self-organization approach, self-organizing predictive model.

Prerequisite for improving medical and social assistance to the population of the Russian Federation, stable and progressive development of the Russian medical-industrial complex (MIC) [1] as a set of interrelated and interacting business entities pursuing in the process of their coordinated functioning one common goal – to ensure valeological and demographic security of the Russian Federation, is MIC focus on innovative development as a way of its existence through targeted changes in its quality as a result of innovation activity in the context of changing environmental factors and / or changing intrinsic properties. Innovative nature of contemporary organizational and economic processes in the medical-industrial sphere imposes special requirements on content, organization, forms and methods of development management of MIC, taking into account the increasing importance of immaterial forms and unconventional qualitative growth factors.

The key to a significant increase in the socio-economic efficiency of the Russian MIC in circumstances where the country is heading towards the information society is the use of possibilities provided to the producers and consumers of health services and medical supplies by modern information and communication technologies, the formation of an Internet-based unified and nation-wide information and communication medical-industrial space (ICMIS) as a form of existence of relations taking shape in the process of implementing health activities by MIC entities, using information and communication technologies [2].

For management of innovative development of the Russian MIC in the information society, it is advisable to use intelligent management technology, including or based on the theory of functional systems by P.K. Anokhin [3]. MIC, like all other complex socio-economic systems, is a functional system. The effect, contributing to the goal of a functional system, is reached based on self-regulation. “What do we mean by self-regulation? It is the situation when the medical community is responsible for the quality of work of every doctor” [L. Roshal, 4]. The issue of ICMIS involvement in the process of forming a self-regulatory system of medical and social assistance to the population of the country is pressing.

Using the possibilities provided by the information society, it is possible to create an intelligent management system of innovative development of MIC, which is a set of technical and software tools, unified by a single information and communication process and operating in cooperation with man (group of people), able to, based on the information about the state of the environment and its own state, as well as the forecast of these states, given motivation and constantly updated knowledge regarding many different aspects of medical-industrial activities, generate a management goal, make decisions and find rational ways to achieve the goal [5]. Building an intelligent management system of innovative development of MIC assumes implementation of a mechanism of management goals generation, dynamic expert system, methods of self-organization, decision-making and forecasting, unified in the functional structure developed by P.K. Anokhin [6].

In the most general case, it is supposed to use the appropriate system economic-mathematical models for modeling and forecasting innovation activities in the medical-industrial sphere.

At the stage of Russia's transition to market economy, Hermeyer type models deserve special attention [7]. Hermeyer systems have no dependency relations: in market conditions, economic relations between entities are based on the principles of equality, autonomy of will and property of their participants.

In the medical-industrial sphere, in the class of Hermeyer type systems, models designed for the following tasks are the most relevant:

- optimization of the ratio of funds received by MIC from three sources: government, business entities and population (the main, global, purpose of the "government - MIC business entities - population" system is to ensure valeological and demographic security of the Russian Federation);
- reallocation of resources of state non-budgetary social funds: from the Social insurance fund and the Pension fund to the Fund of compulsory medical insurance (the global system goal is improving the socio-economic efficiency of preventive, diagnostic, therapeutic and other activities aimed at maintaining and improving the health of Russians);
- optimization of allocation of resources of compulsory medical insurance (CMI) between the Federal and regional CMI funds (the global system goal is improving the quality of health services in the regions);
- financing the modernization and development of MIC organizations from the budgets of all levels and funds allocated by business entities engaged in business activities in the market for medical services and medical supplies (the global system goal is improving the quality of medical care provided for Russians);
- strengthening the role of public associations of MIC organizations, medical and pharmaceutical associations and public organizations of physicians and patients in health management (the global system goal is improving the situation with socially significant diseases in Russia).

Where there are dependency relations, MIC and its subsystems can be considered as active systems [8]. In active systems, one or more controlled entities – active elements – can deliberately choose their state, guided by personal interests and preferences.

In terms of the theory of active systems the following tasks can be identified:

1. improving the management efficiency according to the scheme: territorial health management authority $\rightarrow$ accountable organizations;
2. improving the management efficiency according to the scheme: CMI regional funds and health insurance organizations $\rightarrow$ prevention and treatment facilities (PTF) tied by contractual relations;

3. improving the management efficiency according to the scheme: Chief physician of a prevention and treatment facility → medical personnel of PTF;
4. development of integral assessment methods for performance measurement of services, units and divisions of MIC;
5. improvement of the supply system organization, performance of works and services for the needs of state and municipal healthcare;
6. improving the efficiency of the drug supply system for state and municipal PTF;
7. improving procedures for licensing and accreditation of healthcare entities;
8. increasing the reliability of results of examination of medical aid quality;
9. development of methods for assessing the quality of healthcare services;
10. improving procedures for certification of medical and associated services;
11. improving the training quality of doctors and pharmacists;
12. improving management of the development of priority areas for medical science and technology;
13. improving the efficiency of health and social monitoring system.

For qualitative analysis of innovation processes in the medical-industrial sphere, it is advisable to use the methods and means of the self-organization theory, i.e. synergetics [9]. From the viewpoint of the self-organization theory, ICMIS is a kind of a virtual ground where there is a constant exchange of different value factors relevant to human health. With the development of exchange processes in ICMIS, social community of participants of medical-industrial processes is also developing, their value orientation is being identified, while the ways of their communication over the Internet are improving. In this context, models of the following major components of the MIC innovative development process in ICMIS are the most relevant [10]:

1. information development of ICMIS;
2. economic development of ICMIS;
3. entrepreneurial activity of MIC entities in ICMIS;
4. development of science in ICMIS;
5. professional training of health officials and managing medical officers;
6. elaboration of collective decisions aimed at improving the socio-economic efficiency of MIC.

These models of innovative processes, characteristic of MIC, representing equations with a fixed structure, in ever-changing operating conditions and state of MIC often become inadequate. In this regard, building predictive models, including dominant (key) parameters of MIC, is proposed to be done using a self-organization technique [11]. Self-organization avoids unnecessary and casual relationships and connections between the system elements. It is also essential that the self-organizing models can be built while MIC is functioning.

The adequacy of self-organizing models is determined by the minimum number of selection criteria for the models – a set of complementary criteria. By cleverly selecting these criteria, we can eliminate irrelevant state variables to determine their relationship most accurately.

The intelligent management system of innovative development of MIC operates as follows. The first stage consists of selection (culling) of all scenarios, which are inacceptable according to selection criteria. The remaining scenarios undergo further selection and arranging; the best one is executed. In each subsequent step, using updated information on operating conditions and own state of MIC, the scenario selection procedure is repeated, while maintaining some old scenarios.

In intelligent management systems of innovative development of MIC, a method for building predictive models based on a combination of statistical and expert information can be implemented. When forming the action acceptors of intelligent management systems, based on

the theory of functional systems by P.K. Anokhin, a method for building predictive models, based on a combination of statistical and expert information, should be combined with the self-organization approach.

Self-organization is the most effective approach given the minimum amount of a priori information, as well as in cases where, for various reasons, some important factors are not considered or when interference is several times bigger than the desired signal. The principal possibility of prediction with a lack of information about some of the key factors relies on the fact, that in complex systems all factors are intercorrelated; each measured factor will provide information on other related factors.

Methodological prerequisite for the use of the self-organization approach when building predictive models is the assumption that all necessary data that characterize the dynamics of the research object are contained in the information on its operating conditions and its state, as well as in the set of selection criteria. Applying the approach of self-organization, it is possible to build a mathematical model of the research object without a priori statement of its behavior. The developer just needs to specify the set of selection criteria; a model of optimal complexity will be chosen automatically.

Within the approach of self-organization, a self-organization method, which is based on the following principles, is implemented:

2. Principle of the model self-organization.

It is based on the fact that in the process of selection of predictive models according to the set of criteria, the complexity of the model structure grows, while the criteria values decrease. Achieving minimum criteria values indicates a model of optimal complexity. Further criteria values remain constant or increase.

1. Principle of external addition (S. Beer).

Prerequisite of solving the problem of choosing the model of optimal complexity is the introduction of an external selection criterion, calculated based on the information, that is not used in the assessment of the model parameters, performed with the help of a learning sequence.

1. Selection hypothesis.

According to the selection hypothesis in deterministic formulation, all impacts, which did not overcome a self-selection threshold in the previous row, will not participate in the formation of the best result in the next row. For most heuristic selection criteria, the selection hypothesis can be proved only in the probability meaning.

1. Principle of freedom of choice – inconclusiveness of an intermediate solution (D. Gabor).

In order to ensure freedom of choice in the selection process, several models are transferred for each next step from the previous one.

The adequacy of the chosen model is confirmed by achieving the minimum selection criteria. The correct choice of selection criteria allows excluding from consideration all irrelevant, random and uninformative states.

The most famous selection criteria for models include regularity criteria (mean-squared prediction error of the test sequence), minimum model displacement (normalized sum of squared differences of the output values of two models, obtained for two different subsets of the original data set), balance (projected value in any remote reference point). The criteria of argument diversity, model simplicity, information etc. are less common. They all have their specific drawbacks. Thus, in particular, the application of the balance criterion, choosing the model with easily traceable general patterns, revealed in the process of observation, can lead to multiple model selection, because, as a rule, at each time interval there are many models which correspond to a common pattern formed earlier.

In the first phase of systemogenesis, the set of selection criteria consists mainly of general criteria – regularity, minimum displacement, balance, etc. In the second phase, the set

of selection criteria will consist of one general criterion (e.g., regularity) and several special ones.

Using the set of selection criteria, it is possible to make a choice of the predictive model clear. The criteria, each of which exercises multiple options, are collectively applied to the models, already selected with the help of auxiliary criteria, which in every particular problem formulation are selected usually from physical considerations.

The predicted state of the studied system will be used in the quality functionality, which is minimized when searching for optimal management. Management generation with forecast optimization is conducted periodically, taking into account new data.

The process of building a model based on self-organization is performed in three stages:

1. Building a generator of applying models.
2. Assessment of the generated applying models according to selection criteria and selection of the best of them.
3. Use of the selected predictive model for extrapolation.

The self-organization method is applicable in cases where measurements provide enough information about the dynamics of processes, occurring during the operation of the studied system, i.e. when the effect of measurements aging does not strongly affect the accuracy of the predictive model. When measurements aging critically affects the accuracy of the predictive model, an algorithm based on time series is used. The accuracy of the predictive model can be improved by means of expert information used in its building. The error ratio in the action acceptor of the intelligent management system can be regarded as an indicator of the transition from self-organizing predictive models to predictive time series.

The self-organization method is used in heuristic self-organization systems. The central element of a heuristic self-organization system is a generator of hypotheses, which is a program generating random combinations of input signals – arguments and their functions. In addition to the generator of hypotheses, the system includes a unit of self-selection thresholds for useful information based on heuristic criteria and a unit of thresholds optimization. Although in general the number of possible combinations of input and intermediate signals can be very big, self-selection thresholds for useful information allow reducing the scope of the problem, and thanks to the thresholds optimization procedures it is possible to achieve maximum accuracy of its solution.

Building the intelligent management system of innovative development of the Russian MIC is associated with a number of significant problems. Serious difficulties arise primarily out of implementation of mechanisms for the generation of management goals, as well as formation and functioning of the action acceptor. Goal generation and formation of the action acceptor in the management system of innovative development of MIC are performed by industry executives in the context of legal, economic and other limitations. In such a situation different human errors are inevitable which can have serious consequences for both MIC and specific social groups, rights and interests of which will be violated, and Russian society as a whole.

In the information society, the intelligent management system of innovative development of MIC can be built based on MIC information and analytical website [12].

In the intelligent management system of innovative development of MIC, MIC website performs the following functions (Fig.1):

1. collection, accumulation and storage of information about the state of MIC and the state of its environment;
2. generation of management goals based on active assessment of information about the state of MIC and the state of its environment, as well as the forecast of these states given motivation and expertise;

1. formation and development of the knowledge database on many different aspects of medical-industrial activities;
2. development of assessment required for decision-making, as well as the forecast for the action acceptor;
3. decision-making;
4. verification by the action acceptor of compliance of the action result (in case of implementation of the selected management) with the forecast.

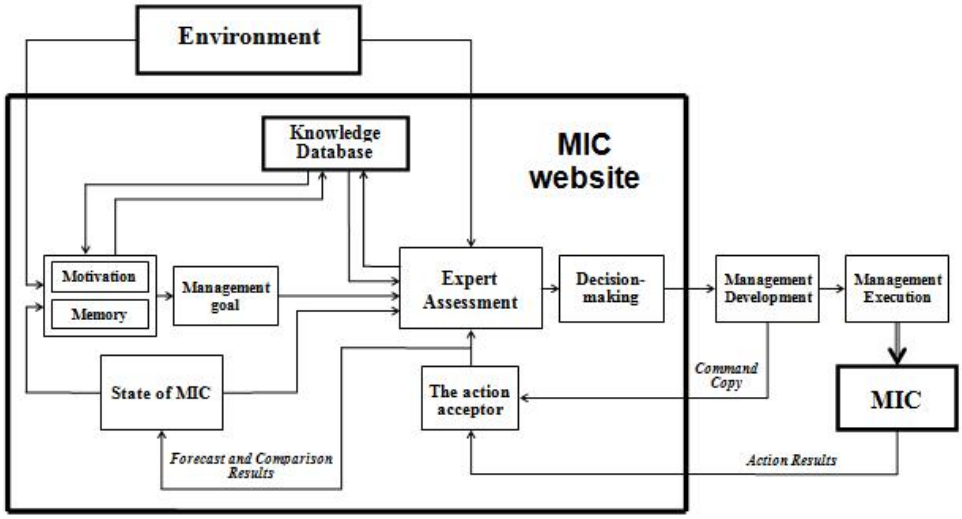

Fig.1. The structure of the intelligent management system of innovative development of MIC, built on the basis of MIC website

The action acceptor operates on the basis of self-organizing predictive models of innovative processes in the medical-industrial sphere. Report on compliance of the action result with the forecast is transferred to the expert system and the system of goal generation. If the action result corresponds to the forecast, the management goal is considered achieved, and the selected management is deemed correct. In case of discrepancy between the action result and the forecast, a new expert assessment is performed, a new solution is adopted and new management is implemented. If the compliance cannot be reached even theoretically, there is a change in management goals – a new goal is generated.

Members of a valeological Internet community forming around MIC website, focused on solving urgent problems of public health and healthcare, will act as experts in the intelligent management system of innovative development of MIC

In the management system of innovation processes in ICMIS, the following self-organizing model can be used for prediction:

$$\varphi(x) = \sum_{i=1}^{n} a_i \mu_i (f_i x) \ .$$

Where n is the number of basic functions in the model, μ_i is basic functions of a parameterized set $F_p = \left\{ a_j \mu_j (f_j x) \,\middle|\, j = \overline{1,m} \right\}$ (each basic function is associated with a two-dimensional parameter vector $(a_i, f_i)^{\mathrm{T}}$, where a is amplitude, f is frequency).

Thus, the following general conclusions can be drawn from the above:

1. For management of innovative development of the Russian medical-industrial complex in the information society, it is advisable to use intelligent management technology, including or based on the theory of functional systems by P.K. Anokhin.

2. When forming the action acceptor of the intelligent management system of innovative development of MIC, a method of building predictive models, involving a combination of statistical and expert information, shall be combined with the self-organization approach.

3. MIC information and analytical website can be the basis for the creation of the intelligent management system of innovative development of MIC.

4. In the intelligent management system of innovative development of MIC, MIC website will perform the following functions:

3. collection, accumulation and storage of information about the state of MIC and the state of its environment;

4. generation of management goals based on active assessment of information about the state of MIC and the state of its environment, as well as the forecast of these states given motivation and expertise;

5. formation and development of the knowledge database on many different aspects of medical-industrial activities;

6. development of assessment required for decision-making, as well as the forecast for the action acceptor;

7. decision-making;

- verification by the action acceptor of compliance of the action result with the forecast.

5. Members of a valeological Internet community forming around MIC website will act as experts in the intelligent management system of innovative development of MIC.

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DESIGN OF THE INFORMATION TECHNOLOGIES FOR VARIABLE RATE APPLICATION OF FERTILIZERS

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The foundations of the design of information technology for the differential impact on soil and plants in the system for precision farming are presented.

Keywords: precision agriculture, information, decision-making

Agriculture in Russia, despite the existing difficulties is in need of innovative approaches that use information technology. For developed countries, precision farming is no longer an innovative technology, but in Russia it is still novel and has not been applied broadly.

The Russian agricultural sector, particularly in the area of arable farming and plant cultivation experiences an acute shortage of modern technologies and facilities equipped with computers and modern means of communication. The application of innovative information technologies in this area will improve crop production, reduce costs, the usage of resources and the negative impact on the environment.

The most widely used information technology in agriculture is precision farming, which allows an efficient management of crop production. Precision agriculture uses global positioning systems (GPS and GLONASS), geographic information system (GIS), special sensors, aerial photography and satellite imagery.

The basis of precision agriculture is to characterize soil heterogeneity within the same field. The main purpose of precision farming is to increase the effectiveness of technological operations, the quality of agricultural products and to reduce losses due to variable soil fertility. This naturally implies a differentiated approach to the problem of fertilization, crop protection and seed application rates.

Scientists have long been tackling the issues of optimal resource use in the cultivation of crops based on average values, but not considering the temporal and spatial variability.

With the advent of GPS, electronics and Geoinformation systems (GIS) it became possible to think how to expand the concept of "precision" agriculture to systems with large spatial and temporal variability. Therefore, instead of "precision" agriculture (Precision Agriculture) it is better to use the term "site-specific farming", the agricultural production that considers temporal and spatial variability in fertility parameters.

The main stages in the development of information technology for the differential impact on soil and plants in precision agriculture are:

- Definition of a goal;
- Formulation of the tasks that need to be accomplished to reach the goal;
- Assessment of the initial information required to solve relevant problems;
- Identification of the tools necessary to obtain, process and interpret the information;
- Definition of the requirements necessary for the realization of technological process;
- Inventory of the human, physical and information resources that are available;
- Impementation of the preparations necessary for performance of technological process;
- Collection and analysis of additional data necessary for the implementation of the project;
- Modifications of the realization plan of the technological process after the analysis of the obtained data;
- Implementation of the modified plan;
- Repeat the process.

A successful realization of the technology for a variable rate application of fertilizers within the precision agriculture is possible using systems approach.

The first step is a definition of the goals that have to be reached. At this step it is necessary to consider labor, economic and ecological conditions. The goals have to be differentiated, realistic, and correspond to the opportunities of economy and the level of professionalism of its administrative personnel [1].

While designing a technological process it is necessary to take into account a set of factors, including a feasible ratio between expected profit and the requirements for environmental protection and possible risks.

The most typical factors are:

1. Receiving a maximum yield, disregarding existing restrictions. Such objectives are achieved by maximizing productivity at each field site taking into account the desired yield.

2. Maximizing profit. In this case, an optimization of the fertilizer doses takes into account their cost and expected profit. Such approach is more reasonable as it considers the causes of variability in the soil nutrient distribution and the costs associated with the mitigation of such variability. The problems associated with the existence of sites with low productivity are taken into account. When maximizing the yield, more fertilizers have to be applied to increase productivity. It is effective only when nutrients are a limiting factor. If limiting factors are, for example, soil compaction or proximity of ground waters, such an approach will lead to an unnecessary use of fertilizers. To maximize profit, it is better to reduce fertilization on marginal land. This approach increases the efficiency and reduces the negative impact on the environment.

3. To compensate for the lack of nutrients, fertilizers are applied to sites in strict accordance with the quantity of nutrients that have been removed with a harvest of previous culture. Doses of fertilizer application can be calculated on the basis of yield maps. In this case the maps of fertilizer application will be similar to the yield map.

4. The strategy towards maintaining the balance of nutrients is based on sampling soil nutrients and an assessment of the nutrient concentrations in the soil. Then nutrient concentrations in the soil are compared with the doses of fertilizers recommended for receiving a desired crop yield. The difference between these values is taken into account to further correct the doses of the variable rate application of fertilizers. Such approach is quite straightforward. To implement it, the data on the distribution of nutrients in soil and the recommended fertilizer dose are needed.

Depending on the goal and the formulated tasks different data sets may be needed. The most common ones are the data on productivity, soil characteristics, weather, technologies used, the history of fertilizer use, economic indicators, remote sensing data, etc.

A successful design of information technology for the site-specific use of fertilizers is only possible when adequate supporting information is available – the data on productivity of previous cultures, concentration of nutrients in the soil and the degree of heterogeneity in their distribution, the functions of responsiveness of crops to increasing doses of fertilizers, etc.

When designing such a technology, it is necessary to consider three types of heterogeneity of the fertility and productivity parameters - spatial, temporal and predictable. First of all, heterogeneity has to be measured, then analyzed and only then the correct, effective administrative decisions can be made. Furthermore, it is necessary to assess the performance of a technological process in the system of precision agriculture to achieve success at its realization. Exact and timely information on the character and the degree of variability of parameters of fertility and productivity is necessary for the realization of this process [2].

Goal	Task	Information
Receiving a top yield	Application of necessary amount of fertilizers for the programmable crop's productivity	Model (Responsiveness functions)
Receiving the maximum profit	Optimization of doses of application of fertilizers	Economic model
Compensation of NPK	Input of nutrients (NPK), in proportion to productivity of previous culture	Yield maps and the experts' recommendation
Maintenance of nutrient concentration	Increase the level of limiting nutrients	Diagnostic data of soil parameters and expert advice
Maintaining the balance of organic matter in the soil	Application of traditional technology	Data on changes in the application history of organic fertilizers

Table – Tasks and necessary information for achieving a desired goal

Spatial variability of parameters of fertility and productivity can be measured by means of collecting and analyzing the data on the appropriate indicators in the accepted system of positioning with a strict binding to the chosen system of coordinates. Data on heterogeneity of

productivity can be obtained with combines equipped with yield monitors that are now widely used in most developed countries.

It is possible to assess temporal variability of productivity and parameters of fertility by means of comparison, for example, the yield maps received for a number of years (3 or 5 years).

Predictable heterogeneity can be estimated as a result of comparison of planned, expected results with the actual results. This type of heterogeneity is, as a rule, caused by the wrong assessment of fertility of a field, an error in expected productivity and quality of the crop.

A successful implementation of technology requires appropriate resources. The degree to which a given technology can be realized depends on the availability of resources. First of all, the success depends on the education level, experience and motivation of the personnel. Consultants, suppliers of fertilizers and equipment can be extremely helpful in decision-making. For a successful introduction of new technology it is expedient to create a group (team) where everyone would be responsible for the achievement of specific objectives.

The availability of equipment has a large impact on decision-making and how effectively these decisions are implemented. Therefore it is necessary to devise a plan for the acquisition of the necessary equipment, taking into account financial opportunities of the economy.

When precision agriculture and the variable rate fertilizer application are mentioned, the first thing that a person thinks of is a global positioning system (GPS, GLONASS), Geoinformation systems (GIS), on-board computers and sophisticated machines for the variable rate application of fertilizers. Therefore, it is necessary to begin with the acquisition of a good computer with the memory and software sufficient for storage and processing of large volumes of information. To realize the technology for the differential use of fertilizers, an accumulation and storage of information from a field on crop productivity is one of the major factors. Then it is necessary to acquire reliable system of positioning of DGPS and learn how to work with a GIS system.

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NEW INFORMATION TECHNOLOGY IN RUSSIAN AGRICULTURE MANAGEMENT

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In this work we consider the state of informatization of Russian agriculture and also the scientifically grounded suggestions for development of information system development, Internet technologies within the unified Web space of agrarian knowledge.

Keywords: informatization of Russian agriculture, integrated Internet space of agrarian knowledge, Internet-based technology.

Russia has been falling behind Western countries in terms of informatization of agriculture in the last 30-40 years, as profound changes which have taken place in recent years have not stimulated the introduction of modern information technologies (IT) into agricultural industry.

Disregard to integrated, well-balanced development of information technologies on the grounds of integration of information flows, software, telecommunication devices resulted in the situation we have now – information technologies actually do not work, they do not influence the development of productive forces. At the moment, they create an illusion of their service but in fact they are only an advertising tool.

As a consequence, a "single task-based" method of software development and implementation dominates in agriculture, which presupposes that separate task solutions are purchased from different suppliers, so as a result they have no functional, informational or ergonomic connection, though developed countries understood long ago, that only integrated informatization of enterprises is effective. The "single task-based" approach, in most cases, only damages the very idea of informatization.

Earlier AIAPI monitored the informatization state of agricultural enterprises-members of AGRO-300 club.

Table 1. states the aforementioned trends of "single task-based" approach even at the best Russian enterprises, as exemplified with data on accounting software development. The situation with enterprise control automation software development is the same.

Table 1. Percentage ratio of accounting software developers.

Enterprise type	w/o subconracting	C	Regional organization	Russian organization	Individual person	STI
Agricultural enterprises	23	6	45	6	6	3
Poultry farms	43	6	21	7	0	0
Omsk bacon	80		20	0	0	0

Global experience shows that IT can have significant influence only if Russian agriculture gets to some specific level of informatization and only on the grounds of integrated, systematic approach to development and implementation issues.

All over the world informatization is shifted towards Internet in costs and innovation approaches. The story is repeated at present. Internet technologies develop randomly and this development cannot be controlled by state or governing authorities, that is why the process of their implementation is time-consuming and results in significant resources overrun. Even those insignificant resources, intended for Internet technologies development, are used extremely ineffectively.

Until now we could accept the "single task-based" software development and implementation approach in agro-industrial sector, due to negligible level of enterprises informatization, but uncontrollable development of Internet technologies promises enormous expenses.

For example, as forecasted by the Higher School of Economics, by the end of the decade, more than 50% of Russian economy will be serviced by the Internet.

The situation with Internet technologies in agriculture is even worse. Our institute has analyzed the state and content if websites belonging to agricultural enterprises, websites belonging to Russian agricultural educational institutions, Research Institute of Russian Academy of Agricultural Sciences. So, only about 5% of agricultural enterprises have their own websites, IKS - 48%, Research Institute of Russian Academy of Agricultural Sciences – 50%, agricultural educational institutions – 100%. Therewith, the fullness and organization of the websites is rather low along with rather poor quality of the contents.

Keeping in mind the analysis, we can make the conclusion, that they are looking for ways to inform customers with the help of trial and error method. For example, educational institutions now consider their websites as displays and do not invest in their efficient use. They are focused on applicants for entry and students, rather than on manufacturers, managers, scientists or general public. Some agrarian knowledge is presented on these websites only thanks to enthusiasm of some users who add it. Therewith, we notice the improved competence – there are some electronic catalogues and random full-scale electronic presentation. But there is no well-ordered full-scale electronic presentation.

On the grounds of our analysis we can make one more conclusion. In our country Internet is still considered to be one of types of mass media or a convenient way of visualization. That is why the Ministry of Agriculture of Russia does not place emphasis on the development of information systems (IS) including Management Information Systems (MIS) of any level - from an enterprise to the Ministry of Agriculture of the RF, in the field of Internet-technology. That is why the representatives of agro-industrial sector make mainly display websites. Therefore, people worldwide have already appreciated the great potential of Internet technologies allowing access to different MIS and IS for unlimited number of users. The Internet is considered to be a new evolutionary stage of development of means of informatization.

Therewith, on the grounds of statement, that Internet technology is a component of information technologies, technologies used for informatization should be applied for them. For this purpose a range of methodological principles for information systems (IS) development should be actualized. Those principles were stated by a member of the Academy of Sciences V.M. Glushkov. In particular we should actualize the principle of modularity and type design. The essence of this principle is the identification and development of the most independent parts of systems or modules and their maximum use in different subsystems.

It should be noted that the modularity and type design principle should be taken as the basis for development of IS in agriculture, as there is a great number of typical organizations there.

Taking into account the aforementioned data, AIAPI offered to promote informatization and Internet-technology within the Unified Web Space of Agrarian Knowledge (UWSAK) from unified scientific and methodological positions [1]. The possibility of UWSAK development is verified on the grounds of economic and mathematical modeling.

UWSAK is the integration of studies, publications, advising activities, regulatory information, distance learning, application program packages, databases, developed by Research Institute of Russian Academy of Agricultural Sciences, agricultural educational institutions, agro-industrial publications and publishing houses, UWSAK and other organizations working in agricultural sector from a unified position in order to facilitate the search of necessary information supported by a single provider and a powerful DBMS based on unified classifiers, e.g. state rubricators of scientific and technical information GRNTI and all-Russia product classifier OKP. The integration specifies development of typical website for a research institute, educational institutions, agricultural enterprises, information and advising

centers, including the following chapters: Scientific support for agro-industrial production, Documents management, Statistics, Digital market, Digital employment center. All of them are meant to facilitate access to informational Internet resources, free transfer to manufacturers and support of ready sites by a single provider.

Gathering these types of unified agrarian knowledge into a powerful data base management system (DBMS), capable to process millions of copies of entries with a sufficient speed on the grounds of GRNTI, OKP will allow processing different analytical information, including: forming different ratings, samplings, groups, calculating citation indexes, revealing plagiarism, and as it was mentioned before bringing together sellers and buyers with calculation of transportation leg and costs optimization, performing stable migration of labor resources, leasing software, performing price monitoring etc.

For these purposes, on the grounds of the results of analysis of different agricultural websites, the structures of the above specified typical websites have been offered and partially programmatically implemented.

Therewith, it will be possible to save more than 1 billion RUB a year only on websites development and support. This type of UWSAK portal realization will allow agriculture to enter to informational community eventually.

Certainly, the complete realization of such a breakthrough project, innovative not only for Russia, but also for the whole world, seems to be impossible at the moment. We think that the best solution is the following: to try to gather everything we have in electronic format (publications, researches, distance learning, advising services etc.), develop competent architecture for their presentation in the Internet and start its step-by-step implementation.

At the following stages there should be developed databases, application program packages, programs for development of agriculture informatization identified in the project [2].

The first stage of UWSAK development does not require considerable expenses, unlike the realization of industrial design technology, information systems development and implementation.

As for the application program packages, especially those related to management information systems, instead of rushing to develop them we should study new management methods first. There was time, when introduction of agricultural machines changed the structures of agricultural manufacturing and management and control systems. PC implementation was supposed to have similar consequences, but it didn't happen so. Accounting may serve as a typical example. Now it is based on multiple manual aggregation of primary information about a technological operation in view of different aspects. All the modern software aimed to automate accounting repeat this technology. At the same time, computers are capable to store and perform calculations on the grounds of primary information without making temporary analytical databases.

The practice of computer implementation demands formalization of general principles and methods of production process organization and management, providing effective use of labor, material, power and informational resources.

More and more management functions can be automated by means of standards development and managers training on some standard management functions and also due to extended technical capabilities of hardware and software.

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MODELLING REGIONAL ALTERNATIVE MANAGEMENT SCENARIOS WITH FUTURE CLIMATIC CHANGE INFLUENCE ACCOUNTING

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The methodology of construction of the alternative agricultural production scenarios at regional level includes profitability and feasibility analysis based on assessment the effect of global climate change on productivity parameters for the main agricultural crops, cost efficiency of crop growing and cattle breeding. To propose links between economic adaptation to climate change and carbon (organic C) stock management in agricultural ecosystems for use in developing long-term adoption strategies at regional level, the regional economic-mathematical model was elaborated. It allows us to unify soil C driving variables and human environment factors.

Keywords:Regional Economic-Mathematical Model, Regional Alternative Management Scenarios,Climate change,Linea Programming Task, Model of humus balance,European Russia

Abbreviations:

BAU Business-as-usual management scenario
OPT Optimal economic management scenario
SUS Environmentally sustainable management scenario
HadCM3 Hadley centre climate model Version 3
SOC Soil organic carbon
GIS Geographical information system
IPCC Intergovernmental panel on climate change
SRES Special report on emissions scenarios
RAPS Regional agricultural production systems
FYM Farm yard manure
N Nitrogen
C Carbon
BCP Bioclimatic potential

Scientific evidence about the seriousness of the climate threat to agriculture is now unambiguous, but the exact magnitude is uncertain because of the complex interactions and feedback processes in the ecosystem and the economy. Five main factors will affect agricultural productivity: changes in temperature, precipitation, carbon dioxide (CO2) fertilization, climate variability, and surface water runoff. Initially, rising atmospheric concentrations of carbon benefit crop growth and could offset yield losses from heat and water stress (World Bank Annual Report, 2007, Focus F).

Agricultural intensification and expanding cropland area can potentially lead to additional greenhouse gas emissions (Smith et al. 2007a). The three most common approaches to estimate the impact of climate change on socio-economic systems in agriculture are cross-sectoral models, agronomic-economic models (Rounsevell et al. 2006) and agro-ecological zones (AEZ) models (Mendelsohn et al. 2001; Fischer et al. 2005; Metzger et al. 2006; Schroter

et al. 2005). The first two approaches usually do not include adaptation, while the more comprehensive AEZ approach gives the best estimates based on existing soil-climate-crop relationships. For using AEZ as a forecasting tool, linking economic variables into the AEZ model is necessary.

The objectives of this study were to: (1) develop a set of indicators for representing sustainable development of Regional Agricultural Production Systems (RAPS), (2) integrate the impacts of different plausible future climatic changes into consistent future scenarios for RAPS, and (3) propose links between economic adaptation to climate change and carbon (organic C) stock management in agricultural ecosystems for use in developing long-term adoption strategies at regional level.

Main results of the research:

We propose a system of indicators for express analysys of regional agro-ecosystem (fig.1).

Sustainable agriculture indicator for express analysis of RAPS		
Theme	Sub theme	Indicator
Capital	Economic results	Renovation index
Nature capital	Materials consumption	Fuel per hectar
	Soil assets	Humus balance
Human capital	Incomes difference	Products consumption per capita in groups with different incomes
Integrated capital	Sustainable development	Integrated indicator: carbon dioxide (CO2) fertilization

Figure 1. Indicator system for express analysys of regional agro-ecosystem

The resulting indicators value are driven by some economic regulators. Among them are the external and internal ones.

The external regulators are the incomes of the people.

The internal regulators are the structure parametres of the RAPS:

- *the renovation index* depends on the invesment volume;
- *fuel per hectar arable lands* depends on area structure;
- *humus balanse* depends on fertilizer doze (organic and mineral) and area structure, different groups percent in the cattle herd, animal rations structure;

The main market regulator : *the part of sold agricultural production* . The investment structure depends on the part of sold agricultural production, depends on the *consumption volume and structure*, depends on the income level.

Integrated indicator: carbon dioxide (CO2) fertilization is a complex characteristic of the RAPS development.

For cropland, the activities that have the highest potential for storing C are afforestation, conversion of cropland to permanent grasses and conservation tillage, and better use of organic inputs (Smith et al. 2000). Lower C storage potentials include changing crop rotation, expanding the use of winter cover crops, eliminating fallow periods, changing fertilizer management, using more organic soil amendments, improving irrigation, shifting land to conservation buffers and restoring wetlands (Lewandrowski et al. 2004; Smith et al. 2000).

Table 1. Comparative scenario characteristics

Scenario	Business-as-usual BAU	Optimal management OPT	Economically and environmentally sustainable SUS
Criteria definition	No criteria	Maximum profitability (P to maximum)	Maximum P with (ΔSOC) ≥ 0 constraint
Crop yield calculation*	No climate effect on current crop yield	Economic effective yield change projected at 10-year intervals	
Crop rotation	Current 2000 rotation	New rotation pattern based on economic model outputs	
Crop growth parameters	Shifts in vegetation period according to crop growth model outputs		
Fertilization	Current 2000 rates years	Mineral N and FYM– optimal for plant nutrition , FYM rates based on outputs of economic model, correction for not exceeding ecological safe rates	

* percentage change from average 1990-2000 data for the administrative regions

To integrate the impacts of different plausible future climatic changes into consistent future scenarios for RAPS the principles, shown in the table 2, were applied.

Three land management scenarios were generated as follows: the business-as-usual scenario (BAU), the optimal economic scenario (OPT) and the economically and environmentally sustainable agriculture (SUS) scenario (table 3).

The BAU scenario (without the implementation of any adaptation strategy, with indicators value, shown in the table 1) assumes crop yield change in 2000-2070 for fixed crop rotations and fertilisation patterns. N mineral and FYM fertilisation rates were assumed to stay the same as in 2000 and applied to the most valuable cash crops in the rotation.

Among the different management practices that can potentially lead to C sequestration, the following have been tested: cropping rotation change, improved crop nutrition, organic fertilisation and more extensive use of perennial crops. Because the effects of the practices are interactive, several key factors were taken into account to make predictions feasible, (a) the possibility for increasing primary production is based on the positive effects of future climate on crop productivity and also on improved crop nutrition (Izrael and Sirotenko 2003), and (b) the introduction of cropping systems that include perennial forage legumes or grasses, based on regional demands of fodder for cattle breeding and adequate supply of mineral N.

Intensified cropping systems were proposed where climate change lengthens the growing season, thus enabling early ripening crops, with winter crops to reduce the period where the soil is bare. On the other hand, the fallowing frequency was increased in the continental south-east regions of Russia where the arid farming zone is expected to expand, with severe limitation of crop yields through reduced water availability.

The OPT scenario assumes an optimal RAPS structure and rotation for maximising profit. Yield forecasts of the Soil-Climate-Yield model (Sirotenko et al. 1995) for optimal N fertilisation in dryland conditions were used. Fertilisation rates in the OPT and SUS scenarios can alleviate nutrient mining and thus prevent depletion of the SOC pool whilst enhancing crop residue inputs (Janzen et al. 1998; Lai 2004). N fertilisation rates and timing were also optimised based on fertiliser recommendations for optimal yields. FYM rates were equal to outputs of livestock farming production of the region and were not allowed to exceed ecologically safe rates.

In the SUS scenario, profit maximisation was additionally restricted by imposing the condition that management must maintain or increase soil C. The combined effect of different management practices on steady-state C values was estimated using the static Model of Humus Balance (Shevtsova et al. 2003) and only those found to maintain or enhance SOC levels were used. The SUS scenario assumes that row crops are mostly replaced with grasses in crop rotations. As this model was developed for soddy-podzolic soils, the last scenario was implemented for only 19 of the 47 regions, i.e. those with podzoluvisol soils.

The main parts for the following research work were:

- model for alternative management scenarios assessment elaboration;
- model calibration on regional information.

The regional economic model is a core model for research, which tracks the processes of crop agricultural production, livestock farming and fodder production, as well as soil fertility reproduction, defined for the available land resources of the RAPS. Economic data necessary for constructing alternative management scenarios from 47 regions of European part of Russia for period from 1990 to 2005 were collected. The regional economic model e includes an interrelated system of several submodels (fig.3), which tracks the processes of agricultural crop production, livestock farming production (separately for different animal systems), fodder production and soil fertility reproduction, defined for the available land resources of the RAPS. Relationships within the each submodel are based on balance calculations, linear and nonlinear functions and normative information. The model outputs for future scenarios assume regional RAPS change as a result of land-holder adaptation to climatic change only in the livestock farming and cropproduction sectors. A distinct feature is the assessment of soil fertility dynamics based on driving parameters from other submodels (crop yield, mineral and organic fertilizer rates, etc.).

The model provides information on costs, incomes and profits for the specific production practices (including crop rotations and production inputs) using a whole-system approach.

The RAPS parameters that define the profit gain or loss are the percentage of cows in the cattle herd, and the share of marketable production in the crop sector. Percentage of cows in the cattle herd determines whether a farm specializes in milk or meat production. Milk production in most regions of Russia is currently profitable, but meat production is not (Agriculture in Russia 2002, 2006, 2010). The ratio of market prices for different types of agricultural production is considered to be stationary. Linking of the model results with map units is based on the definition of a 10-year crop sequence within the calculated crop pattern. Changes in the livestock farming and crop production sectors are based on the solution of general linear programming (Ognivtsev and Siptitz 2002; Romanenko 2005b, c).

The main output parameters for evaluation include the structure of arable land, application rates of FYM and mineral fertilizers, percentage of cows in the cattle herd, the structure of livestock feed rations, and the share of marketable production in the crop growth sector.

Regional specialization in the long-term is connected with changes in the highest possible yield for the main crop/region driven by climatic scenarios. Baseline figures of crop productivity were average yield data for 1990-2000 for the administrative regions, available from agricultural statistics (Agriculture in Russia 1998, 2002). The procedure of scenario construction includes the following successive steps:

- summing croplands for all crops within the classes: cereals, row crops, and grass;

- defining the dominant crop within each class/region (potatoes or sugar beet for row crops, wheat or barley for grain crops, etc.);
- identification of attributive data (the highest possible and real yields, sale price of the specific product, etc.)
- assuming only dominant crop growing within the class; and calculation of costs for the specific crop across regions.

The normative sources for determining the structure of livestock farming and crop production sectors within each unit are soil texture, initial soil C content (soil database), potential yield of the main crops (a dynamic crop growth model Climate-Soil-Yield outputs according four different climate scenarios; Smith and Powlson 2003; Smith et al. 2007b, c), milk, livestock and crop production input and output standards per 1 U (head) and 1 ha (Kuznetsov et al. 2002), metabolizable energy and dry matter per unit weight of the feedstuff component (Planning Agriculture Handbook 1974), constraints on regional crop rotation systems and share of the foodstuff components in animal rations (Planning Agriculture Handbook 1974), with correction of mineral fertilization rates so that they do not exceed ecological safe rates.

The crop model projected grain crop (with no detail for the specific cereal) and grass yield changes, given as percentages under limited or optimal N fertilization in dry-land conditions (Sirotenko et al. 1995). Simulated climate outputs were the same as those used in Smith et al. (2007c), i.e. data 2000-2070 from the HadCM3 climate model (IPCC 2001) using four IPCC emission scenarios—A1FI, A2, Bl, B2 (Nakicenovic et al. 2000)—were used for the crop modelling. HadCM3 provides a warming projection for the region by the year 2010 in the middle of the range given in IPCC. The climate database with 0.5° resolution and monthly mean data was used as inputs for those sites within the administrative divisions at which the crop model was run. Other model outputs include a shift in emergence and harvest dates due to climate change, and changes in crop growth rate in the specific administrative divisions (Sirotenko et al. 1995).

Baseline figures for the calculation of crop productivity change were average yield data for 1990-2010 for the administrative regions, available from agricultural statistics. Change in the yield of row crops was calculated separately for sugar beet, sunflower, fodder roots and potatoes as follows: modern agro-climatic analogues of future climate were found based on the sum of $T > 10°C$, the vapour deficit and the temperature of the coldest month of the year (Sirotenko and Pavlova 2003). For the RAPS systems without adaptation, current yields of modern analogues were used for the economic modelling. For the system including adaptation, the highest possible yield under optimal mineral fertilization strategy of the current agro-climatic analogue for the specific row crop/region was used (Methodology and standards of estimation mineral fertilizer requirements in agriculture, 1983). At the same time, extrapolation from the modelled grain crops and grasses based on the statistical approach for row crop yield prediction was unsatisfactory. The possible role of soil in this is important, but its exact role remains uncertain and adds complexity to the assessment. Besides, analysis of potato yields under optimal fertilization revealed only small changes from region to region.

The economic model describes the crop rotation structure as the percentage of cereals, row crops and grass (annual or perennial). Defined rotational patterns for each region were constructed based on a 10-year crop sequence, in accordance with agricultural statistics and expert knowledge. The output percentages were rounded to the nearest 10. The procedure of assigning specific crops to the specific year in the RAPS was followed by identifying the sowing and harvesting dates and the fertilization pattern during the 10-year rotation. Future sowing and harvesting shifts were available for spring cereals and grass as outputs of Climate-

Soil-Yield model, or were set using expert judgement for winter cereals and row crops, based on the analysis of dynamics of the vegetation periods from current agro-climatic analogues.

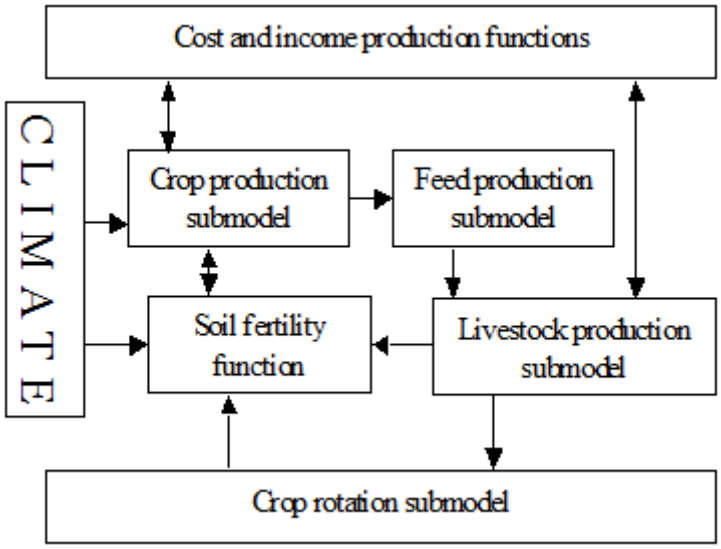

Figure 2. The economic-mathematical model structure

The list of necessary equations(functions) in the model includes:

- Soil fertility function (Humus balance);
- Manure production function (depends on livestock structure and number);
- Livestock structure and number functions (depends on feed production volume and structure);
- Feed production volume and structure (depends on crop production volume and structure);
- Crop production structure (depends on arable land structure);
- Crop yield functions;
- Cost functions for crop and livestock production (Fig. 2).

A distinct feature of the model is the assessment of soil fertility dynamics based on driving parameters from other submodels (soil texture, initial soil C content, the arable land structure, crop yield, mineral and organic fertilizer rates, etc.).

Livestock production input and output standards per 1 U (head) are based on the metabolizable energy and dry matter per unit productivity (weight and milk) of the feedstuff component (Planning Agriculture Handbook 1974). That's why the number and structure of the cattle herd depends on the arable land structure and crop yield.

Climate-Soil-Yield crop growth model was used for yield forecasts (Sirotenko et al., 1995). It takes to account the resource variability (such as water and nutrients, bioclimatic potential). A dynamic crop growth model Climate-Soil-Yield (Sirotenko et al. 1995) has been run separately for each 10-year interval for all Russian and Ukrainian administrative regions (2000-2050), and the results of the crop model were then used as inputs for the economic model to select adaptation strategies.

The economic model solves a profit maximization routine based on costs and profits per unit of production using linear constraints, the main of which are:

arable land cannot exceed the amount existing in the region;

percentage of cows in the cattle herd cannot exceed 67% (reproduction constraint); and

share of the foodstuff components in animal rations is not more than normative ones.

Criteria description

$$P = \sum_{\tau=1}^{T} [\Omega \sum_{i=1}^{K} \delta_i s_i(\tau) Y_i(\tau) C_{i\,prod}(\tau) + N(\tau)\{\alpha(\tau) U(\tau) C_{milk}(\tau) + M(\tau) C_{meat}(\tau) - Z_M(\tau)\} - \Omega \sum_{i=1}^{K} Z_i(\tau) s_i(\tau)] \rightarrow MAX\{s_i(\tau), N_y(\tau), \delta_i, \alpha(\tau)\},$$

P – profit, rub.;

Ω – arable land of the region, ha;

τ – year number, $\tau \in 1 \div T$;

δ_i – the share of sold i-crop production;

$s_i(\tau)$ – the share of the i-crop in the arable land of the region;

$Y_i(\tau)$, $C_{i\,prod}(\tau)$ – the yield (tones per hectar) and the price (rub.)of the i-crop production unit;

i – the type of the crop production, $i \in 1 \div K$;

N (τ) – the number of cattle herd;

α(τ) – the share of the cows in the herd;

U(τ) –milk productivity per cow, kg;

$C_{milk}(\tau)$, $C_{meat}(\tau)$ - the milk and the meat unit realization price, rub.;

M(τ) – meat productivity per head, kg;

$Z_M(\tau)$ – production costs per head, rub.;

$Z_i(\tau)$ – production costs per hectar of the i-crop (rub.).

Parameters to determine:

- Arable land structure, s_i (τ)
- Fertilizer doze (organic and mineral), $N_y(\tau)$
- Cows percent in the cattle herd, α(τ)
- Part of marketable production in crop sector, δ_i

For definition of geographical subdivisions with unique sets of driving variables several maps were used. The Soil Map of the Russian Federation, the Map of Land Use in the Soviet Union, the Map of Natural–Agricultural Zoning of the Soviet Union were adjusted to administrative boundaries of 47 administrative regions in the European Russia, which are the basic units for agricultural statistics and economy analysis (Rukhovitch et al., 2005). The linked land-use, soil and meteorological layers give 200 units characterised by the maximum possible uniformity with respect to climatic, soil, economic, and land-use parameters.

Economical expertise of crop productivity forecasts makes it possible not only to define agronomically feasible yields, but also top define an inter-related set of other management and economic parameters of specific land management practices which have been verified in many environments.

Profitable agriculture management scenarios were built for 47 regions of European Part of Russian Federation; for each region according to 4 climatic scenarios with 20 years step (2010, 2030, 2050) a linear programming task was solved to find an optimal structure of land-use with profit maximization;

Sustainable agriculture management scenarios were built for 19 regions of Nechernjzemnaya Zone of Russia; for each region according to 4 climatic scenarios with 20 years step (2010, 2030, 2050) a linear programming task was solved to find an optimal structure of land-use with profit maximization plus $\Delta C \geq 0$ constraint, where ΔC is soil organic carbon (SOC) per year balance.

The model provides definition of the following variables, which characterize different land use systems:

Crop area structure, share of different livestock groups, organic and mineral fertilizer doze.

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FIELDS OF APPLICATION SOCIAL NETWORKS DATA IN ECONOMIC PRODUCTIVITY

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This paper addresses the issue of using social networks data for business needs to gain economic productivity. The first half is devoted to operation's features with program interfaces of popular social networks: Vkontakte, Facebook and Twitter. It shows how to get data from these social networks, extract information and what the main problems are. The second half is devoted to possible task for economic productivity.

Keywords**:** social networks, vkontakte.ru, vk.com, facebook.com, fb.com, access token, big data tasks, application of big data.

According to IBM strategic forecast, all companies in the next 5 years will be divided into winners and losers depending on quality of making corporate decisions. Research and case studies provide evidence that a well-designed and appropriate computerized decision support system can encourage fact-based decisions, improve decision quality, and improve the efficiency and effectiveness of decision processes. IBM Watson, for example. In 2012, IBM opened for the partners the possibility of learning the technologies, on which Watson was created.

On a business, social media gives a great opening door to reach much more people you may need for your business needs. Technologies of analytics and forecasting the future situation depending on made decisions (predictive analytics) allow being on some steps ahead of emergence of threats. These technologies are already used in many developed countries. So

how should system for collecting and analyzing the unstructured information work? What should we do?

Almost all social networks and many information portals and forums use asynchronous data loading by means of AJAX technology, Javascript (ECMAscript) uses for simplification of data handling in the browser and the data transfers in a type correspond to the object notation of this language - JSON, rather than in the form of XML or separately pieces of the HTML code. In social networks it led to development of the special API, which allow to develop independent applications or parts of sites at observance particular rules of reversal with the information. Therefore it is logically to use javascript for organizing and handling data. Unlike most of conventional web-servers, API servers of social networks do not allow to produce parallel requests and can enter restrictions not only on all requests, but also on each type of request separately. Therefore each scanner of a social network has only one boot stream that addresses to a social network connection station, but not directly to the API server. The social network connection station is separate for each social network and performs the following functions:

- initialization of interaction with a social network;
- support of the active connection properties with a social network;
- automatic generation of new properties after period of validity finishing or request from a boot stream;
- conversion of received requests from a boot stream in the form of JSON object in a HTTP request line.

All social networks APIs work within the limits of the protocol of authorization ‘OAuth’, however implementation of this protocol varies. Let’s have a look at a working process with a few social networks’ API.

Vkontakte

The social network Vkontakte demands presence of the generated key 'access token' for access to the data, however this key is necessary to receive only with the received permission through the browser. Therefore for connection automation Vkontakte emulates operation of the browser to receive of authorization properties of the user that is registered in the browser as keys of cookie. Thus, they are the following:

1. the script loads main page of a social network to receive form of authorization and keys
2. account’s parameters of a social network set in form’s parameters and the request of authorization with transfer of all parameters from loading main page
3. the answer of a social network represented a set of new preparatory session keys and redirection page, on which working keys of session will be generated
4. the script updated the information in the keys storage of cookie and follows to the redirection link
5. on redirection page preparatory keys of session are changed by working keys of session and the redirection link to user’s profile page in a social network
6. After receive of working session keys the connection station will produce request ‘access token’, thus there are a following
7. the script requests special generated link which includes access parameters that request by the application with usage of working session keys which was received during authorization
8. as a result of request there can be 2 situations:

(a) resolution were requested earlier, answer: redirection link with access token like a identifier of an anchor who afterwards cuts from the link using regular expression

(b)resolution were not requested, in this case the answer represents notice form of argument solicitation of access, a script analyzes this form and emulates click button of confirmation, receives as the answer the link of redirection with access token included

After receiving of access token it's possible to use requests with pay load. In our case, we unload all arguing from interesting groups and public messages. For this user account enters to all interesting groups and a script periodically requests the list of user groups, for each group requests the list of arguing, for each arguing requests the list of comments which save separately in the form of the prepared text files.

The social network Vkontakte allows to request not more often than 3 in a second, however in practice notice messages appeared already at frequency 2nd requests in a second therefore the time delay between requests in 2/3 seconds.

Facebook

The social network Facebook demands presence of the generated key 'access token' for access to the data, however this key is necessary to receive only with the received permission through the browser. Therefore for connection automation Facebook emulates operation of the browser to receive of authorization properties of the user which registered in the browser as keys of cookie. Thus, they are the following:

1. the script loads main page of a social network to receive form of authorization and keys
2. account's parameters of a social network set in form's parameters and the request of authorization with transfer of all parameters from loading main page
3. the answer of a social network represents a set of new preparatory session keys and redirection page, on which working keys of session will be generated
4. after receiving of working session keys the connection station produces request of access token, thus, they are the following:
5. the script requests special generated link which includes access parameters that are requested by the application with the use of working session keys which were received during authorization
6. as a result of request there could be 2 situations:

(a)resolution was requested earlier, answer: redirection link with access token like an identifier of an anchor that afterwards cuts from the link using regular expression

(b)resolution was not requested, in this case the answer represents notice form of argument solicitation of access, a script analyzes this form and emulates click button of confirmation, receives as the answer the link of redirection with access token included.

After receiving the access token, it is possible to use requests with payload. In our case all subscribed information can be unload, there are pages of the profiles, separate messages or comments. For this purpose:

- the account of the user marks objects which are interesting for him
- the script periodically requests the list of objects of interest:
  - for each page requests the list of the messages,
  - for each message requests the list of comments,
- messages and comments are saved separately as prepared text files.

The social network Facebook does not confine requests to time frame, however does not allow to implement some requests in parallel and the data from complex requests can be sent too long (till 20 minutes)

Twitter

The social network Twitter demands presence of the generated key 'application identifier' for access to the data, secret keys of the application and access token, these keys are necessary to receive through the administration form of the application on the developer's page.

In connection with the 'simple authorization' in a social network Twitter has upgraded additional security measures for access to data:

1. each request needs to be sign in special way, using date of request for hashing, request data and secret keys of the application, the signature and other parameters of security transfers through the special generated cookie's values.
2. on each type of request there is a separate limit of requests for a 15-minute time frame
3. For script adaptation under various restrictions enters into requests queue function of freeze of separate requests groups. The social network API server in this case produces auxiliary parameters in the form of 'cookie' which contains:
4. the number of requests which can be implemented for this type of request in a 15-minute time frame
5. number of unused requests in a 15-minute time frame
6. starting time of a new temporary window.
7. Using these parameters is very simple and easy to freeze and defreeze separate groups of requests queue
8. We can implement pay load requests right away. In our case all subscribed information can be unload, there are pages of the profiles. For this purpose:

(a) the account of the user marks objects which are interesting for him

(b) the script periodically requests the list of objects of interest. For each page the list of the messages is requested. Messages are saved separately as prepared text files.

Use cases

In 2013 EC-leasing Big Data Competency Center started to search for applicability of the Big Data technologies for the solution of economic tasks. Currently the continuous monitoring of cyberspace carries out analysis of the changes and forecast of situations. Millions of text messages are processed per day. The list of tasks bellow gives the information about solutions in this field to reach the economic productivity tasks:

Early diagnostics of financial instability of the credit organizations.

More than 4 million messages of bank topic from social networks and popular bank resources are already collected. The model of forecasting the dynamics of outflow of deposits was created, based on predictive analytics. A prototype, which allows to estimate the forecast of outflow of deposits of natural persons, using arriving data, was presented.

Assessment of degree of satisfaction of clients services

Log records of Service Desk were analyzed in automated mode. The technology allows revealing regularities of emergence of failures, to trace deviant activity of the personnel, to form recommendations for various incidents based on the latest experience to receive an assessment of degree of clients satisfaction.

Counteraction to insiders and market manipulation

This technology, applied to identification of the facts of distribution of the classified information on social networks, it is possible to use for further creation of system of continuous monitoring of social networks and blogs for counteraction to the insider activities. More than 14 million messages from social networks were processed for the test use case to test the technology.

Identification of affiliated persons for implementation of response measures

The analysis using the tool IBM i2, primary developed for the British secret intelligence service (MI6). For identification of cases when real (beneficial) owners of the organization act in the interests of the third parties. The graph shows the information provided by the mass media, such as RIA Novosti, RosBusinessConsulting, Kommersant, Fontanka, Vedomosti, Interfaks, AK&M, Rospress, Rosbalt, ITAR-TASS, Kompromat.Ru, Ekho Moskvy, etc. More than 3 million messages have already been analyzed for creation the social graph.

Definition of people psychotypes

Definition of psychotypes of human beings is carried out on the basis of the analysis of the text messages placed by them on social networks, at forums or through e-mail messages. The knowledge of psychotypes allows to pursue competent personnel policy, to form effective teams, to prevent emergency of the conflicts in teamwork. Also, it can be applied in the credit score models for identification, for example, the "bad"/"good" debtor.

Analysis of companies' production stability

On the basis of modeling of changes of various factors, including macroeconomic, the assessment and the forecast of production stability of economic entity is given. This information, in particular, can be used for specification of quality of a credit portfolio. Also, it can be applied in techniques of definition of the "bad" / "good" debtor – the legal entity.

Conclusion

R&D use cases performed by the EC-Leasing IBM Big Data Competence Center give us the following fundamentals. Data level from social network exponentially extends and can be used for many use cases leading to economic productivity. The quality of prediction of the situations increases due to opportunity of the decisive center for daily processing of millions text messages from social networks, forums, sites etc. and due to increases of intellectuality of the decisive center at the expense of machine training and predictive models.

Mentioned use cases show that forecast based on social network data can be used for real business cases to improve the efficiency and effectiveness of decision-making processes. Considering the USA experience in Big Data technologies, seriously transformed the banking, insurance and investment market, it is possible to assume wider applicability of the IBM Big Data tools in Russia.

The new IBM Big Data technologies provide the speed and flexibility for social network data processing and give the opportunity to develop systems for solving new business challenges using social network data.

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INCREASING MANAGEMENT EFFICIENCY DISPROPORTION of REGIONAL HEALTH CARE SYSTEM BASED ON OF THE USE OF CLUSTERING AND SYSTEM APPROACH

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Article is devoted to the analysis of disproportions in health care of the Republic of Bashkortostan, the main types of disproportions, characteristic for regional health system are allocated. It is offered to use system model of health care which basis indicators of efficiency of activity of executive authorities are for alignment of disproportions. On these indicators calculation of integrated estimates of efficiency of municipalities which were used for carrying out the cluster analysis is carried out.

Keywords: disproportions, health care, system model, efficiency indicators, ranging, integrated estimates, cluster analysis.

Generally disproportions are meant as discrepancy of potentials or rates of development of separate parts of a certain system therefore the part of the general potential or a product remain not demanded. In case of economic system of a disproportion conduct to unproductive losses of working hours, material resources and the capitals. Disproportions testify to hypertrophied development of one sectors of economy at the expense of others, to lack of balance of economic processes [6].

In the conditions of a transition period in Russia instability and variability of the social and economic environment, in particular health care subsystems considerably amplified, and one of the main reasons for this process is different deepening of disproportions. Their definition and the account are among the main prerequisites of effective management of health system in new economic conditions. Elimination or at least reduction negative for health system of consequences of disproportions will allow to improve its functioning significantly. Therefore use by governing bodies by health care of information on group of the main disproportions – an important condition of increase of system effectiveness.

Proceeding from statistical data, the following classification of disproportions in health care (figure 1) is offered.

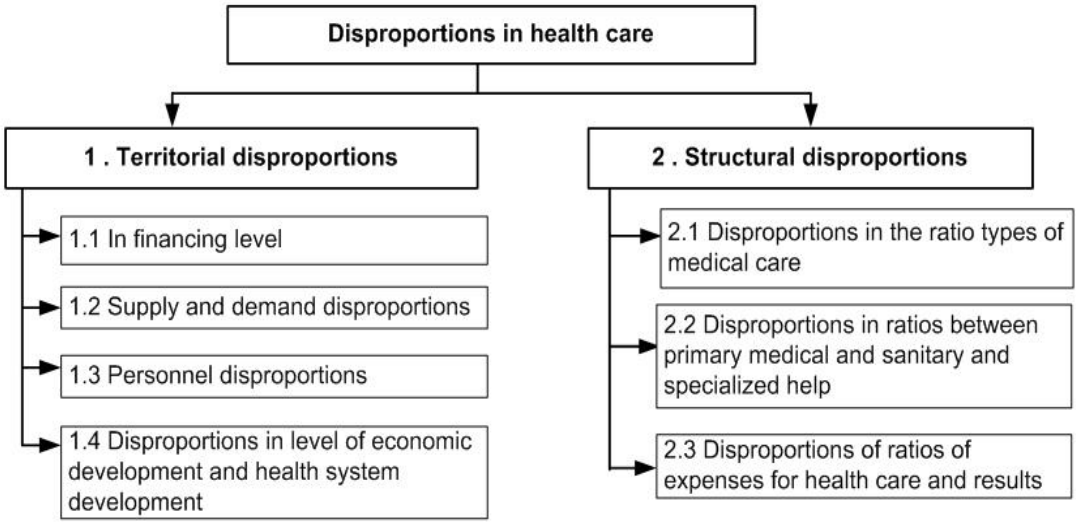

Fig. 1. Classification of disproportions in health care

Further the statistical analysis of each type of disproportions, characteristic for regional health system is carried out.

In health care it is conditionally possible to allocate two types of disproportions.

The first type - the territorial disproportions characterizing imbalance of development of health system on a territorial sign. Disproportions concern to them in level of financing, a supply and demand disproportion, personnel disproportions, disproportions in level of economic development and health system development. We will carry out the analysis of territorial disproportions in regional health system.

Elimination of disproportions demands application of effective administrative influences. For the solution of this task it is offered to use system model of management of health care (Figure 2) within which the health care is considered as the social and economic system which main objective is preservation and recovery of population health, therefore, object of management of health care at regional level is health of the population of the region.

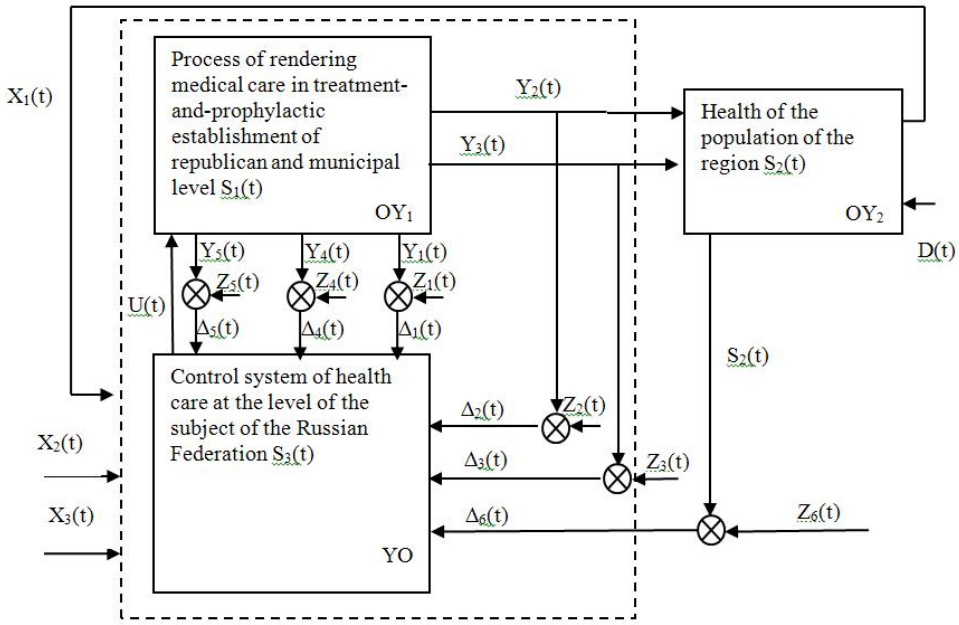

Fig. 2. The scheme of management of health care at regional level

In the presented scheme six groups of indicators, namely characteristics of entrances – *Xi*, characteristics of exits – *Yi*, the characteristic of internal state – *Si*, the management characteristic – *Ui*, target characteristics – *Zi*, environment characteristics – *Di* are considered.

Health of the population is characterized by the large number of indicators designated on the scheme by a vector of *S2(t)*. However it is conventional that health of the population depends far not only on health system functioning, but also on a large number of other factors designated on the scheme by a vector of *D(t)=<D1(t), D2(t), D3(t)*, …>, such as

• the social and economic – a standard of living, unemployment rate;

• social and psychological, having impact on behavior of certain people, groups and collectives – level of stresses, valuable orientations and priorities concerning health;

• political, characterizing a political situation;

• the climatic;

• scientific and technical factors – level of medical and administrative technologies, use of scientific achievements in health care.

The specified factors are, most likely, objects of management of all directions of social and economic policy. Therefore population health on the scheme is taken out for a framework of a control system by regional health care.

In structure of a vector of *S2(t)* it is possible to allocate a subgroup of indicators of *S2i(t)* depending mainly on efficiency of functioning of health system and in significantly smaller measure – from other factors. The indicators of this group most recognized in world practice are indicators of infantile, child, maternal mortality, and also such indicators as a myocardial infarction mortality, degree of efficiency of rendering medical care.

Process of rendering by the medical care, being internal object of management of system regional health care, is characterized by a set of indicators of *S1(t)*. For example, in structure of a vector of *S1(t)* it is possible to allocate the following organizational components: *S11(t)* - indicators of material security; *S12(t)* - staffing indicators.

The condition of a control system of health care is characterized by *S3(t)* vector. In particular it is possible to carry structural characteristics, extent of transition to system of single-channel financing, extent of standardization to these characteristics in the course of rendering medical care.

Entrances for a control system of health care is the vector of *X(t)* in which structure it is possible to allocate a vector of *X1(t)* of indicators of health of the population of the region, defining demand for medical care, a vector of indicators of *X2(t)* defining level of financing of regional health system from various sources and a vector of *X3(t)*, characterizing operating influences from the federal center. Set of these vectors forms a basis for management of process of rendering medical care.

Exits of *Yi(t)* are the productive indicators which assessment allows to estimate system effectiveness of health care. In structure of an output vector are allocated:

Y1(t) – volume and structural characteristics of process of rendering medical care;

Y2(t) – qualitative characteristics of process of rendering medical care;

Y3(t) – characteristics of medical efficiency of process of rendering medical care;

Y4(t) – indicators of social efficiency;

Y5(t) – indicators of economic efficiency.

Basis for decision-making is comparison of indicators of activity of regional health care to achievements of other countries and regions. For a similar comparative assessment the vector of *Z* target characteristics is used. First of all, it is *Z1* indicators - volume and structural characteristics of process of rendering medical care in other regions and the developed countries; *Z2* - qualitative characteristics of process of rendering medical care in other regions and the developed countries; *Z3* - indicators and standards of medical efficiency in other regions and the developed countries; *Z4* - indicators of social efficiency in other regions and the developed countries; *Z5* - indicators of economic efficiency in other regions and the developed countries; *Z6* - indicators of a state of health of the population in other regions and the developed countries.

By results of comparison of exits of *Y(t)* with target characteristics *Z* control system forms a vector of operating influences (administrative decisions) *U(t)* to which it is possible to carry *U1(t)* – characteristics of efficiency of use of financial resources, *U(2)* – characteristics of level of introduction of new methods of the organization and management of process of rendering medical care.

According to characteristics of *Ui, Zi* and *Di* it is difficult to allocate indicators for the statistical analysis, and it is a subject of separate research. As showed the analysis of official documents of executive bodies of regional health system and the corresponding statistics, characteristics of environment and the characteristic of efficiency of health care in the developed countries practically aren't used as reference in the course of adoption of administrative decisions in a control system of health care of the Republic of Bashkortostan.

For reduction of dimension of the solution of a complex problem of management by disproportions in republican health care from six classes of indicators of system model of health care three were allocated: characteristics of entrances – *Xi*, characteristics of exits – *Yi*, the characteristic of internal state – *Si* that, in general, corresponds to cybernetic model of a black box.

In an assessment of efficiency of activity of executive authorities of the Republic of Bashkortostan, according to departmental data, 62 indicators by means of which it is possible to characterize rather in detail indicators of entrances, exits and internal state participate. Also there is a wide range of indicators of data of groups in the statistical collections formed by annually Medical research analytical center. All these indicators were used in total for calculation of an integrated assessment of municipal areas. The integrated assessment decided on use of a method of ranging, calculations were carried out as follows: ranks of municipalities were determined by each indicator, with the best value of an indicator the rank equal to unit was appropriated to the area, then from the remained areas the best was selected and the rank equal to two, process was appropriated to it proceeded, yet all areas weren't ordered until then.

The integrated indicator of group (characteristics of entrances, exits, states) was calculated with use compound ranks of municipalities on separate indicators. Such approach allowed to compare among themselves the indicators having the different physical contents and units of measure.

The received integrated estimates of municipalities were used for carrying out the cluster analysis for the purpose of formation of several clusters having a considerable community on indicators of functioning of municipal health systems.

Researches in the field of management of disproportions are devoted to the analysis of problems of interregional differentiation in development and to a choice of optimum methods of regulation. Thus issues of quantitative measurement of disproportions aren't resolved up to standard. In this regard the cluster analysis as the tool of a quantitative assessment of level of differentiation in development of the sphere of health care of municipal regions was used.

The most obvious and significant is the disproportion of expenses for health care and results of system effectiveness of health care. The statistical analysis revealed contradictions in increase in financing and efficiency of activity of this sphere. The pair coefficient of correlations equal 0,17 that allows to estimate narrowness of communication of these two indicators testifies to very weak, positive communication between indicators. The areas receiving good financing not always show good results by efficiency of activity, and vice versa.

For the purpose of allocation of group of areas with the most expressed disproportions of expenses and efficiency the cluster analysis by a method of k-averages with Statistica 7.0 package use was carried out. Results of the cluster analysis are presented in figure 3.

The most expressed disproportional ratios of expenses and efficiency the 2nd cluster in which at high values of financing system effectiveness of health care is lower than an average on the region possesses.

The following regions belong to this cluster: Beloretsky, Buzdyaksky, Meleuzovsky, Miyakinsky, Sterlibashevsky areas, the cities – Kumertau, Oktyabrskiy, Salavat, Sterlitamak, Ufa.

For identification of the reasons of low efficiency of health care in these regions, despite high level of financing, additional researches are necessary. It is necessary to analyse indicators material and staffing of municipal health systems, and also system of the indicators characterizing influence of environment on activity of municipal health system.

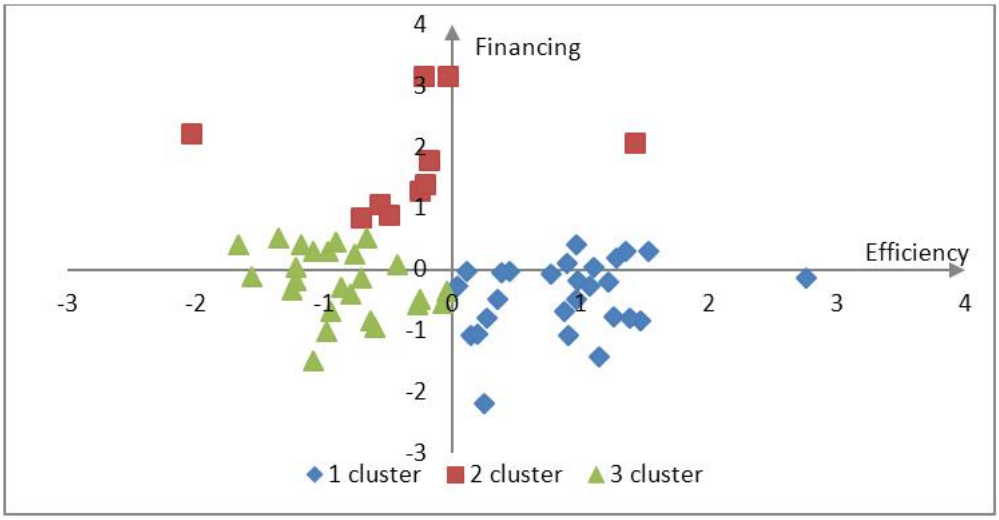

Fig. 3. Results of the cluster analysis

The clustering allows to unify process of adoption of administrative decisions and development of actions for their realization in a control system of republican health care that,

certainly, will lead to increase of system effectiveness of health care of Republic of Bashkortostan.

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IT SERVICES AS DRIVERS OF SERVICE AND MANUFACTURING INNOVATION ACTIVITIES.

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The paper discusses the innovative potential of the sector of IT services in Russia. Using original survey data we prove knowledge intensity and high innovativeness of this sector. Then we analyse the feedback impact of IT services on their customer industries. We provide empirical evidence to the fact that customers' propensity to all types of innovation increases when due to the co-production and use of IT services. We conclude that its ability to innovate and to incent innovations makes IT services the source of sustainable post-industrial growth in both service and industrial sectors of Russian economy.

Keywords: IT services, innovative potential, customer co-production, incentives to innovate

IT can be seen as a twentieth century technological revolution in service industries, analogous to the transformation of manufacturing in the nineteenth century through the use of new power systems. In other words, IT is the growth driver of the post-industrial economy while new sources of power appeared to be the drivers of industrial economy. In the historical

context, "industrial economy" was a synonym to "developed economy" up to the second half of the 20th century. But since then the structural changes in the world economy crowded the heavy industries to the periphery of the global economic development. Developed economies are now the service economies, where services generate from 2/3 to 3/4 of GDP, and the dominating 5th technological mode is the IT-based mode in general. Nowadays "developed economies" are synonymic to "service economies", and IT thus became the main driver of their economic growth.

The post-industrial mode of production and living is thus the seminal area for the service–dominate logic (SDL, see Vargo and Lusch,). This way of thinking suggests treating any production, whether manufacturing or service, as the mean for providing the final consumer satisfaction. The satisfaction is provided not by the product itself, but by its ability to serve the consumer's needs. In this sense, any production is ultimately the production of services, and the IT sector is the brightest example of this approach due to its post-industrial nature.

Following the service-dominating approach, we study the IT sector in the Russian economy as the production of the IT services as its final product. In this sense IT-services are part of the broader study of the knowledge-intensive business services (KIBS), thus positioning our study into the more general framework of KIBS studies, that are at the edge of contemporary post-industrial research.

Data and Methodology

The data used here derive from specialised surveys that have been undertaken in Russia, covering 60-80 producers of IT-services annually for each year across 2007-13 (The surveys are designed by the Institute of Statistical Studies and Economics of Knowledge (ISSEK) and are conducted by ROMIR Monitoring using original topic guides and questionnaires developed specially for this research.). The core of the surveys was replicated across this period, but some questions were only asked in particular years, so our reporting below will use data from various years according to availability. The sample consists of Russian-based producers of IT-services selected annually based on their reported turnover. Companies were invited to take part in the survey consecutively. If the invitation was rejected, the next invitation (to a company with the next highest turnover) was sent out, otherwise the next invitation was only sent out if the total sample size for this sector was below 60. Occasional severe delays with replies or replies from firms that earlier rejected the invitation resulted in minor deviations from target 60 firms annualy, which does not affect the total sample quality. Executives of these firms answered questions on their own company and on the more general market developments. All surveys are anonymous, some firms may be included in several surveys (not necessarily successive), but it does not alter the generalised results. We cannot prevent one and the same firm from taking part in several consecutive surveys, yet our results are always based on a cross-section analysis, therefore this dynamic double-counting, or potentially misbalanced panel, has no effect for any particular year reported.

While we cannot match specific users and suppliers, we have also opportunities to draw on data about the users of the IT-services. In 2007, 2011 and 2013, a survey parallel to that of the suppliers covered over 700 business consumers of one or more of the KIBS services, including IT-services. Each of the business consumers were asked about their experiences with each of the types of KIBS used by the company.

The questionnaires included few repeating questions. Usually every year was devoted to the thorough investigations of some specific topics of KIBS production and consumption. That's why further in the text we use empirical data obtained within different waves of surveys.

Main results

The providers of IT-services can be treated as service organisations that play at least triple role in the contemporary economic growth: first, they are extremely knowledge-intensive;

second, they are innovative by themselves, third, they improve their users' propensity to innovate.

In other words, they are technology-intensive; learning about new ways to accomplish their goals by applying IT; and set off on trajectories of service innovation based on this use.

Our first result is the evidence about the knowledge-intensity of IT service sin Russia. The literature on KIBS usually proposes three main characteristic of knowledge intensity: 1) educational attainments of the workforce that are associated with the level of professional skills; 2) share of the value-added, and 3) share of customized services. Table 2 summarises the evidence along all three lines:

Table 1. Main characteristics of knowledge intensity of Russian IT services (percentage of answers)

Educational profile:	
2 higher educations or MBA	10,5
higher education	80,5
secondary education	9,0
Share of value added in total sales	79,2
Share of customised outputs in total sales	40,3

Source: ISSEK-ROMIR survey, 2007

So, in Russia the providers of IT services usually hire personnel with at least higher education, and the educational level is thus much higher than in the economy at the whole, which employs about 35 per cent of people with higher education. IT sector may also be viewed as the value-added center, because the average share of the value added by Russian manufacturing industries is 28 per cent of total output. And the customised production, where every unit of output is in fact a product innovation, exceeds 40 per cent, so in fact every second unit of output is product innovation. Following these criteria, we may certainly characterize Russian IT-services as knowledge-intensieve.

No wonder that this knowledge-intensive sector is also the center of innovation activities. The share of innovative output in this sector is impressive not only against the background of general economic activities, but also against the average level of the ICT sector on the whole (see Table 2).

Table 2. Share of innovative outputs in 2011, (percentage of total sales)

Mining and quarrying	6.7
Manufacturing	6.8
high tech	12.1
medium high tech	12.8
medium low tech	4.1
low tech	3.9
Electricity, gas and water supply	0.6
Services	3.3
ICT	12,9
R&D	23.4
IT services	**38.5**

Sources: Federal State Statistical Service (www.gks.ru); ISSEK-ROMIR survey, 2011.

So the sector of IT services in Russia is a strong generator of innovations by itself. Our evidence provides strong support to the hypothesis about the innovative character of country-based service production.

Innovative potential of the IT sector in Russia however expands far beyond internal innovations. The segment of tailored services produces various feedback effects on innovative activities of consuming sectors. The main channel of feedback is the process of co-production.

The thing is that service providers require a large input of their customers in the production of the service. Examples like auditing (needs accounting information of the customer), design (needs preferences of the customer), legal advice (needs information on the particularities of the case), etc. clarify the concept. In particular, den Hertog (2000) suggests that the consumption of KIBS cannot be separated from their production as the production of services requires knowledge of THE customer as opposed to a representative customer in a particular business area; this knowledge is only available from the customer. This functional integration of external consumer resources is so important that researches name it joint production, or co-production (Strambach, 2008; Miles et al., 1995; den Hertog, 2002), or even co-invention (Bresnahan, 2002) of services.

Russian producers of IT-services report relatively high level of customer integration. We asked them about the level of customer's involvement into co-production, where 1 means minimum participation (no inputs except terms of reference) and 10 – maximum participation (joint project implementation). The score for co-production activity of exceeds 6 out of 10 (see Table 3), indicating that customers do often participate in co-production of their services. The figure is remarkably unchanged despite the recent economic downturn.

Table 3. Co-production of IT services with their customers

2007	2010	2011	2012	2013
6.5	7.2	6.2	6.4	5.9

Source: ISSEK-ROMIR surveys, 2007-2013

The process of co-production of IT services is remarkable not by itself, but because it is in fact the process of mutual learning-by-doing. Many authors emphasize the mutual character of learning process within KIBS co-production (den Hertog, 2002; Antonelli 2000). Many of them show that providers contribute the business processes of their client firms (Tomlinson, 2000; den Hertog 2000; Toivonen, 2004,). These authors prove that co-production upgrades the customer who learns more about his business and acquires information beyond his principal activities.

The co-production of outsourced IT services differs from the customer firm's principal activity by definition. Customers are not educated in the field of service production. The suppliers of IT services estimate that only 40 per cent of their customers have expertise in the services, while 23 per cent have poor or no understanding, and others have but a general idea.

The surveys indicate that customers often do not know exactly what they need at the outset. The clients have only general and fairly nebulous ideas about the service they require, e.g. "I want to upgrade the software for my increasingly complicating business. When the demand is fairly unspecified, it is more difficult to produce a tailored IT service. The suppliers make efforts to specify particular service parameters; this process of clarification may well last into later stages of the relationship.

Four opportunities to improve customers' knowledge about their core activities can be identified:

a) Reflection upon providers' questions and requests can lead the customers to articulate a more comprehensive understanding of their needs, and the state of their business. (Providers of IT-services told us that at the beginning of co-operation the typical client's answer to any question is "Never thought about it before".)

b) In the process of cooperation, consumers acquire general knowledge about their business environment from information supplied by the suppliers of IT services.

c) Communication with service providers reveals new opportunities that customers did not know or failed to appreciate previously. In the IT sector the full variety of services available within the basic platform is am elucidating example.

d) Customers may improve their expertise in problem setting. For example, they may finding that their initial ideas are unrealistic. Their first approaches may meet with huge opposition, or they may be technically unachievable. They can learn to avoid time-wasting, by making more realistic demands to begin with.

Coproduction therefore should upgrade customers, who can learn more about their business and acquire new knowledge beyond their principal activities. Furthermore they can participate in co-creation of innovative services, especially within bespoke production. In this sense, customers acquire additional expertise in knowledge-intensive performance and thus improve their own innovative potential. This argument is supported by survey results. In 2011 we prepared the special section in the questionnaire which was devoted to the impact of KIBS consumption on their users. For IT services we obtained 138 answers from users who represented almost all major industries of the Russian economy.

Table 4 summarises the answers of customers themselves about external effects of their consumption of IT services. They indicate that their general propensity to innovate improves as a result of use of these services (Table 4).

Table 4. The impact of the experience with IT services on customers' propensity to innovate (as seen by their customers)

Positive	Negative	None
73.7	0.0	26.3

Source: ISSEK-ROMIR survey, 2011

Almost ¾ of responding firms reported that their propensity to implement innovations into their core businesses increased due to their involvement into consumption (and co-production) of IT services. The impact was notable (see Table 5).

Table 5. The power of positive impact of the experience with IT services (as seen by their customers).

1	11.0
2	26.4
3	62.6
Weighted average	2.5

Note: 1 means weak impact, 3 - radical impact.

Source: ISSEK-ROMIR survey, 2011

Two third of respondent firms declared radical effects from their consumption of IT services. Remarkably, thse effects distributed among all types of innovations (see Table 6).

Table 6. The power of positive impact broken down by types of innovations (as seen by customers)

Types of innovations	Average impact
Communication	2.60
Product	2.40
Technological	2.40
Organisational	2.20
Marketing	1.90

Source: ISSEK-ROMIR survey, 2011

Though IT services are usually treated as technological KIBS (T-KIBS, see Miles), the technological upgrade of the customers' businesses is on the second place shared with product innovations. The most crucial effects of IT services are on communications with customers' suppliers and consumers. Organisational innovations are also visible by most customer firms. We conclude that consumption and co-production of IT services provide strong and complex positive effects on consuming industries.

The increased innovativeness of customers generates a remarkable feedback effect: 80 per cent of them expand and upgrade their demand for IT services (see Table 7).

Table 7. Consumers' responses to: "How does the increase of your innovativeness impact on your future demand for IT-services" (percentage of responses)

Demand larger amount of services	39.1
Demand smaller amount of services	0.0
Demand more types of services	41.3
Demand fewer types of services	0.7
Demand services more frequently	18.8
Demand services less frequently	0.7
Demand more innovative services	29.0
No effect	19.6

Note: multiple answers possible, thus columns do not add to 100%

Source: ISSEK-ROMIR survey, 2011

This underpins the assertion that improved innovativeness of KIBS customers expands and upgrades their demand; it is the reason for arguing for the self-sustainability of service innovations in the IT sector. More sophisticated demand generates incentives to co-create more innovative services. This upgrades not only the services produced themselves, but also the customer firms as well; additional innovation experience makes them smarter consumers, with higher propensity to innovate. These increased innovation activities are facilitated by support from more innovative services, and thus the whole cycle is liable to repeat in a virtuous circle. This suggests that the IT services may increasingly become the point of sustainable generation of both service and industrial innovations.

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EVALUATION OF INNOVATION

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Summary Text addresses the issue of evaluation of innovation. Framework for evaluation of innovation is introduced. This framework respects two main aspects: pro-innovation environment in the company and benefits of innovation. Pro-innovation environment includes: conceptual activities, resources, management infrastructure and operational management of the innovation process. Benefits from innovations include: benefits from the product innovation, benefits from the process innovation and investment in research.

Keywords Innovation, evaluation of innovation, pro-innovation environment, benefits of innovation.

Introduction

Increase of competitiveness of national economies is considered a major factor in economic growth in the EU. In more detail, then competitive firms of all sizes.

Specification of competitiveness defined by OECD, EU, World Economic Forum (WEF) and Michal Porter's diamond model is not the ambition of this article [1], [2]. The current findings can be generalized to the following conclusions: The competitiveness of the country depends mostly on its productivity and rational macroeconomic policy that creates the right conditions for a flourishing economy and society.

However, the competitiveness from the macroeconomic point of view has its foundations in microeconomics, in a healthy business environment and quality level of competitiveness of individual businesses. The key to their prosperity are concepts such as productivity, innovation and motivation, as shown below.

For a comprehensive view of international competitiveness of the country, ie including both the aspect of economic success, and the aspect of the welfare of citizens, then the above shall also apply to political system and institutions and regional entities of state and public administration (After all, the principle of effective economic behavior based on the best allocation of available resources which is common in the business world is the same for the social, health, cultural, environmental, etc.).

FIG. 1 The relationship between strategy, competitiveness and factors for its implementation.

Source: authors

A recent winter Olympics confirmed some of the changes that are, for many years, typical for the world economy. On the one hand, the emergence of Asian sportsmen and on the other hand, innovation of sports newly included in the Olympics. Similarly, new competitors and innovation move the world economy.

The so-called Oslo Manual (hereinafter OM), which originated in the structures OECD, addresses a number of current topics related to innovation [1]. Among other things, defines innovation and introduces their categorization and establishes recommendations for determining the benefits of innovation. This guidance material is used for example by Eurostat.

Although the current view of innovation recognizes that it can be applied in any human activity (even in the nonprofit sector, government and public administration) as a priority area is considered the business sector, particularly manufacturing and market services (hereinafter the company).

OM differentiates innovation into four categories: product innovation, process innovation, marketing innovation and organizational innovation [1]. Taking into account the benefits of innovation, product and process innovation (they are sometimes known as technological innovation (Technological product and process innovations. This group is subject to the below approach to evaluating innovation activities) can be considered as the key types.

Innovative company in the field of technical innovation, is a company that has applied technically new or significantly improved products, processes or their combination during the reporting period. It is a company that has carried out successful innovative activity in the period. It can be interesting to single out those companies that innovate only "passively" (Technological product and process innovations. This group is subject to the below approach to evaluating innovation activities.), eg through licensing or techniques contained in imported new machinery and equipment.

Product innovation is the introduction of the goods or services that are new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, software, user friendliness or other functional characteristics.

Product innovation can take two forms:

- Technically new products;
- Technically improved products.

Technically new product is a product whose technical characteristics or intended uses differ significantly from those previously produced product. Such innovations may comprise a completely new technique, may be based on a combination of techniques for reuse, or can be obtained by applying the new knowledge.

Technically improved product is an existing product whose scope was significantly raised to a higher level. A simple product may be improved (in terms of improved efficiency and lower cost) efficient use of components or materials, or complex product consisting of a series of integrated technical subsystems can be improved by partial changes to one of the subsystems (Changes to the product in the form of eg the introduction of fashionable colors, patterns, eg ties, taste and variety of dishes are a group of "other creative product improvement," but not considered a product innovation).

Process innovation is the introduction of technologically new or significantly improved production methods, including methods of delivery of the product. These methods may involve changes in equipment or in the organization of production, or a combination of these changes, and can be obtained using new knowledge. The methods may be intended for the manufacture or delivery of technologically new or improved products, which can not be manufactured or

delivered using conventional production methods, or substantially increase the efficiency of production or delivery of existing products.

Research, development and innovation activities (hereinafter RDI) it is a complex activity, which (at company level) should be obtained new technical knowledge (Whether own or foreign knowledge - the patent, benchmarking knowledge (patent search, knowledge gained from a scientific or technical press, participation in conferences, etc.) and understanding, scientific discovery, enhance professional competence of RDI, development and verification of various product design and / or technology prototype designs, testing, equipment for pilot testing of the product and technology equipment for normal production of innovative products (including testing new materials, security machinery for new production, tooling), license fees, purchase of know-how, etc.

From the viewpoint of a company, there are two approaches to RDI:

- On their own - the company may on its own resources (personnel, finance, facilities, etc.) to do their own research, development and innovation of products or processes,
- External forces - the company buys part or most of the research and / or development and / or innovation activities with external organizations (research institutes, universities, testing laboratories, toolmakers, etc.).

In terms of spending on research, development and innovation, both of the above approaches for RDI are usually of interest.

Evaluation of innovation

Innovation is very diverse and multifaceted, making it impossible to establish a universal or completely resistant tool for the evaluation of innovation. Undoubtedly least reflects the business disciplines or sectors with regard to the cycle of innovation. There is no doubt that there are industries where innovation is the order of the day, or have a very short innovation cycles (not necessarily just about fashion production, but also the production of electronics). On the other hand, product innovations such as pharmaceutical usually require aged research, verification and registration.

In practice it is possible to record at least three types of approaches to innovation:

- The first that seeks to classify innovation depending on its quality level (degree of novelty).
- The second that focuses on outputs, ie effects (usually economic) that will bring innovation in particular producer.
- The third to assess conditions, ie. setting processes within the company in favor of pro-innovative company operations.

In practice, a combination of these approaches is used, ie the setting of pro-innovation environment in the functioning of the company is evaluated as well as the results for the company. It turns out that this evaluation provides valuable output that has a good explanatory power about the prospects of the company and can be a useful complement to the valuation of the company (through an acquisition or merger), but also in providing loans, etc.

Model for the evaluation of innovation

In light of the above, evaluation of innovation in the company can be divided into two groups:

Evaluation of pro-innovation environment in the company

Both strategic and operational activities to ensure pro-innovation functioning of the rated entity, are of interest. Usually, a standardized questionnaire is used for this purpose, which covers all the key areas of company operations that relate to innovation:

- Conceptual activities (the concept of innovation, annual plans for technical development and innovation, financial security plans, systematic monitoring support innovation, collaboration with partners, involvement in clusters, etc.).
- Resources (qualified manpower, equipment, information security).
- Management Infrastructure (documented procedures governing pre-preparation of new products, a clear definition of competencies, application project or product management, implementation of the corporate culture of continuous improvement, etc.).
- Operational management of the innovation process (a clear definition of tasks, deadlines and costs of research, design and innovation work, allocation of responsibilities for various tasks, continuous feedback (audit) in various stages of design, implementation and commercialization of innovation, the application of modern methods in innovative activities).

Evaluation of benefits of innovation

In conventional producers, we can assess their innovation performance eg on an annual basis based on:

- Benefits from the product innovation,
- Benefits from the process innovation,
- Investment in research.

Of course, for each of the above aspects can choose a variety of indicators. The following indicators have good explanatory power and their strength is relatively simple construction and the requirement to input data:

Benefits of product innovation:

$$\text{Share technologically new or improved products in turnover} = \frac{\text{Sales in the reference year for innovative products launched in the last three years}}{\text{Total sales in the reference year}}$$

Benefits of process innovation:

$$\text{Return process innovation} = \frac{\text{The annual benefits of process innovation in the reference year}}{\text{Investments in process innovation}}$$

Investment in research, development and innovation:

$$\text{The rate on investment in RDI} = \frac{\text{The total value of funds invested in RDI in the reference year}}{\text{Total sales in the reference year}}$$

Weights to determine the importance of the pro-innovation environment in the company respectively benefits of innovation depend on the purpose of evaluation. On closer inspection, we can see the differences in the weights attributed to the benefits of innovation. If the company

is primarily focused on product innovation, greater weight will have the benefits of product innovations. If a service-oriented, probably more weight will be given to the process of innovation.

Conclusion

As mentioned in the introduction, innovation is important, often even crucial factor of competitiveness of the economy. As in other areas, management must not focus only on the support, promotion, application innovation, but must be interested in innovative performance. The previously mentioned text brings one of the possible instructions.

Acknowledgement

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FORECASTING LEADING INDICATOR OF INDIVIDUALS' DEPOSITS MASS WITHDRAWAL FOR A COMMERCIAL BANK

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Abstract. This paper addresses the issue of predicting financial instability of a commercial bank. We provide a model for predicting the value of the leading indicator of the event of mass withdrawal of deposit accounts from a commercial bank.

Keywords: bank run, machine learning, forecasting

Individuals' deposits represent the main part of commercial banks liabilities. The sudden mass withdrawal of deposit accounts by individuals leads to immediate bankruptcy of any bank. That is why the problem of forecasting the events of mass deposit withdrawal is among the most important ones for banking supervision authority. Moreover, the authority needs to obtain long term forecasting in order to be able to prevent such event. In other words, it needs a leading indicator of such event. One of possible leading indicators is the indicator of the growth rate of the value of individuals' deposits falling below the average growth rate. In this paper, we provide a model for predicting the value of this leading indicator based on machine learning.

The growth rate of the value of individuals' deposits for a bank i at month t is given by $\Delta_{it} = \frac{D_{it}}{D_{i,t-1}}$, where D_{it} is the total value of individuals' deposits in the bank. We define the average growth rate as

$$\overline{\Delta}_t = \frac{\sum_{i=1}^{N_t} D_{it}}{\sum_{i=1}^{N_{t-1}} D_{i,t-1}},$$

where N_t is the number of active commercial banks on the market in month t. The leading indicator of mass withdrawal of individuals' deposits is defined as

$$y_{it} = \begin{cases} 1, & if \quad \Delta_{it} < \overline{\Delta}_t, \\ 0, & if \quad \Delta_{it} \geq \overline{\Delta}_t. \end{cases}$$

This variable is the target one in our forecasting model. We predict its value from the past values of some other variables, called features or explanatory variables. These variables are

1) natural logarithm of the number of individuals' reviews on deposit products and services;
2) natural logarithm of the total value of legal entities' deposits;
3) natural logarithm of the total value of individuals' credits;
4) relative change in the total value of individuals' deposits (the value of this variable for bank i in month t is given by $\frac{D_{it}-D_{i,t-1}}{D_{i,t-1}}$);
5) maximum deposit rate;
6) natural logarithm of individual income per capita;
7) unemployment rate.

We take natural logarithms of some variables in order to lower the scales of them. We collect the reviews on deposit products from internet forums devoted to banking (banki.ru, bankir.ru) and from social networks (facebook.com, vk.com, twitter.com). The majority of individuals' reviews are negative. That is why the large number of individuals' reviews indicates negative attitude towards the bank. Therefore, the number of individuals' reviews should have predictive power in forecasting the value of the target variable.

The variables 2)-4) as well as the target variable are constructed from official bank reports available at the site of Bank of Russia (cbr.ru). The data on deposit rates are taken from banki.ru site. The variables 2), 3) and 5) reflect the willingness of the bank to attract individual depositors. The variable 4) shows the trend in the dynamics of the total value of individuals' deposits. The last two variables are taken from the site of RBC (quote.rbc.ru). These variables reflect the macroeconomic state.

The values of the features are taken with one lag. That is, we predict y_{it} from the values of these variables for bank i in month $t-1$. Our total sample consists of observations on the banks for which there were at least 200 reviews in our sources of individuals' reviews during 2013 year. The total number of such banks is 38. For one of them, namely bank VTB, the deposit rates are unavailable. This bank was excluded from the sample. For each of the banks we have collected monthly data for target variables and explanatory variables for period from September 2011 to December 2013. The total size of sample is 586 observations.

We have used several machine learning models [1] to build the forecasting model, including

- decision trees (algorithms C5.0, CHAID, Quest, CART),
- support vector machine (SVM),
- logistic regression (Logit),
- neural networks (NN),
- bayesian network (BN),
- linear discriminant models (LDM1, LDM2).

In order to select the best model we first estimated the models using all available observations. The resulting accuracies (which shows the goodness-of-fit) are shown in table 1. We see that the decision trees have the best accuracy. In other words, they fit the data better than the other models do.

Table 1:Goodness-of-fit for all available observations.

Model name	Accuracy(%)

C5.0	78.33
CART	72.7
Quest	71.33
CHAID	71.16
NN	69.8
BN	68.94
Logit	68.09
SVM	66.38
LDM1	65.7
LDM2	65.53

We then studied the dynamics of the accuracy of estimated models on the sequence of training and test samples. For each month starting from February 2013 we used subsample containing all the observations up to the month before this month as the training set and subsample of all the observations in that month as the test set. We used training sets to estimate the models and test sets to assess the accuracy of model on observations, which were not used in estimation process.

The accuracies on train sets for the decision trees built by different algorithms are shown in figure 1. We see that the accuracy of decision tree built by CART algorithm is highly unstable in time. This means that the size of sample is not enough for obtaining robust estimates of the model parameters. Therefore, we cannot use such tree for forecasting purposes. The accuracies for the rest algorithms seem more stable.

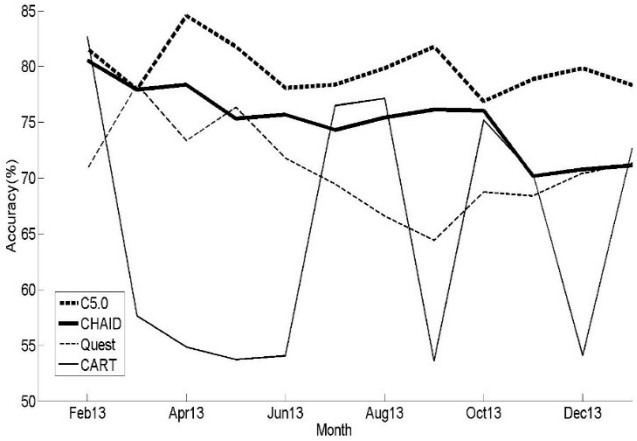

Figure 4: Accuracies on training sets for decision trees.

The next step in model selection was based on the dynamics of accuracies on test sets. These are shown in figure 2. We see that the accuracy of decision tree built by Quest algorithm rarely is the highest one. Therefore we have excluded it from our model list.

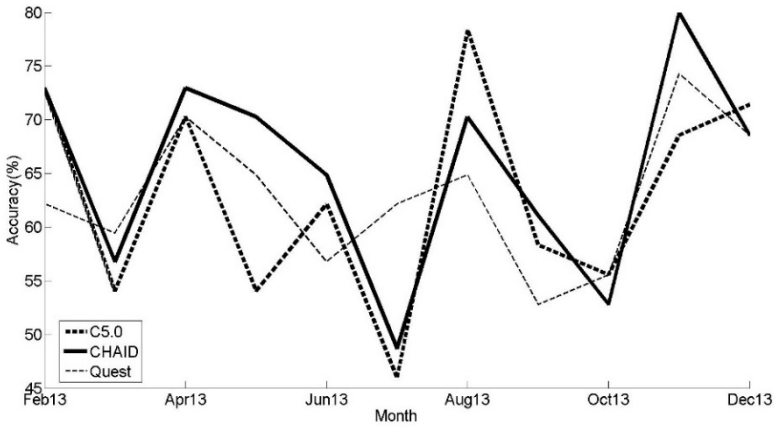

Figure 5: Accuracies on test sets for decision trees (algorithms C5.0, CHAID and Quest).

There is no clear way to select one algorithm between the two remaining ones C5.0 and CHAID. Therefore, we decided to use an ensemble of these two algorithms as the resulting algorithm for building the forecasting model. This means that we combine the predictions from the two decision trees built by algorithms C5.0 and CHAID into a single one. See [1] on how to build ensembles of machine learning models. The accuracies of the resulting forecasting model on the test sets are shown in figure 3.

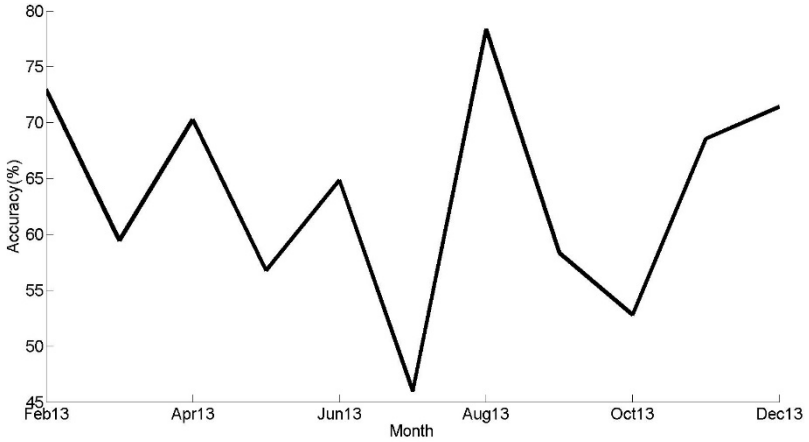

Figure 6: Accuracies on test sets for the final forecasting model.

We used our forecasting model to predict the probability of the growth rate of the total value of individuals' deposits falling below the average level for all banks in sample for January 2014. The probabilities are shown in table 2. If the probability is greater than 0.5 then the predicted value of the target variable is one. Otherwise, it is zero.

Table 2: Forecasts on January 2014.

Bank name	Probability	Bank name	Probability
UniCredit Bank	0.421	Russkiy Standart	0.72
Koltso Urala	0.72	Absolut Bank	0.72
Rosinterbank	0.421	MKB	0.505
Home Credit Bank	0.72	Citibank	0.505
SKB-bank	0.72	Binbank	0.727
Ugra	0.421	TKS bank	0.5
Alfa-bank	0.805	Bank Moskvi	0.421

Vostochniy	0.72	Uniastrum bank	0.72
Sberbank	0.421	RTBK	0.72
Kedr	0.72	Avangard	0.72
VTB 24	0.727	Bankirskiy dom	0.805
Fora-Bank	0.72	Bank Sofrino	0.727
Svyaznoy bank	0.72	RGS bank	0.72
Altayenergobank	0.421	Promsvyazbank	0.727
Moskovskiy kreditniy bank	0.805	TRUST	0.727
Transnatsionalniy bank	0.72	Raiffeisen Bank	0.421
Bank Otkritie	0.72	Renaissance Capital	0.727
Uralsib	0.72		

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URGENT QUESTIONS IN WORK OF GOVERNMENT BODY'S WITH ELECTRONIC DOCUMENTS

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The article discusses the peculiarities of work with electronic documents in government. Regulations which regulate the work with electronic document were analyzed. The statistics of the use of electronic documents are described. Current objectives and problems are considered.

Keywords: electronic document, authority, normative regulation, electronic document management system, interagency cooperation

The main objective and an important task for government are to automate processing of documents and introduce modern information technologies in the work with electronic documents.

This is because Russia plans to join the world's information-oriented society. This is due to the entry of Russia into the global information society, which is currently regulated by the state program "Information Society" [1]. Over the past few years on the basis of a number of government initiatives generated new concepts and ideas.

In the federal executive bodies (federal authorities), as well as in any organ of government, created and used electronic documents created in electronic form without prior documentation on paper , electronic document images obtained by scanning documents stored in electronic document management system (EDMS) .

Electronic document must be issued by the general rules and have office requisites established for a similar document on paper , except for seal and the State Emblem of Russia Emblem or subject of Russia .

Following the approval of the Rules of office work in federal authorities, which first appeared in section 6, which aims at organizing and conducting electronic workflow transition to e-government [2], for further development of the regulatory framework of electronic document adopted Resolution of the Russian Government [3], approving the Regulation on interagency electronic workflow (IEW). This Regulation is the regulatory framework for the

creation of a unified infrastructure for legally significant electronic interaction between the government and local authorities.

IEW system is a secure IT system, providing interaction of federal EDMS.

At the first stage the participants of IEW are federal authorities, the Administration of the President of the Russian Federation and the Government Office of the Russian Federation.

IEW allows participants to:

- send and receive electronic orders and decisions of the President and the Government of the Russian Federation;
- obtain information about the progress of federal executive orders of the President and the Government of the Russian Federation;
- send electronic reports to the President and the Government of the Russian Federation;
- make in electronic form to the Russian government draft legislation prepared by federal authorities ;
- conduct electronic conciliation on draft legislation.

IEW system allows exchange of information by means of electronic messages, which consist, on the first stage includes electronic images of documents originally created on paper. In what is supposed to pass on the exchange of documents that have no analogue in the paper and created exclusively in electronic form.

To regulate relations in the use of electronic signatures in the provision of public and municipal services, the performance of state and municipal functions in the commission of other legal actions, the Federal Law "On electronic signature" [4]. The Act stipulates that "the kinds of electronic signatures used by the executive authorities and local governments , how to use them , as well as the requirement of ensuring compatibility of electronic signatures in the organization of electronic interaction between these bodies are established by the Government of the Russian Federation."

This federal law defines the types of electronic signatures: a simple electronic signature and enhanced electronic signature. The reinforced unskilled electronic signature and reinforced qualified electronic signature are highlighted. Article of the law fixes the conditions for the recognition of electronic documents signed with electronic signature equivalent documents on paper, signed handwritten signature.

Requirements for the organization of exchange of electronic documents have also been fixed in the State Standard R 53898-2010 [5], which are released in late 2010.

For signing electronic documents in federal authorities used electronic digital signature (EDS). Means used EDS to be certified in the prescribed manner.

There intensity uses EDS in federal authorities shown in Figure 1.

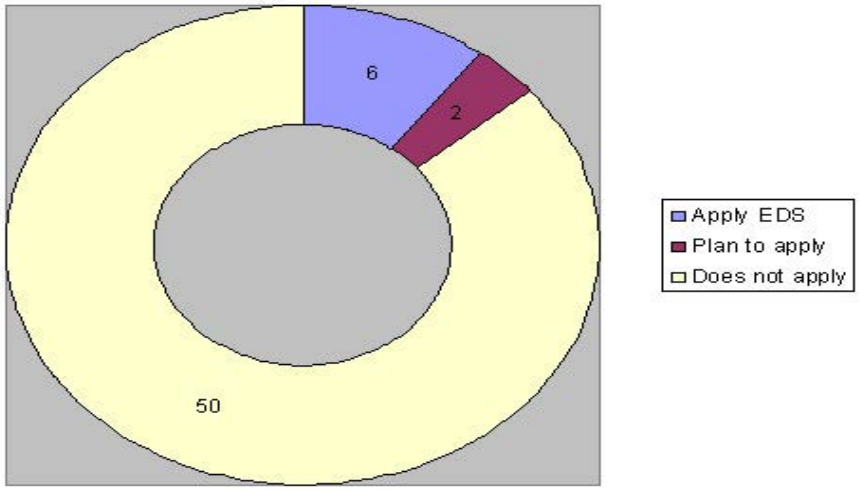

Figure 1 - Using EDS in federal authorities

When considering and agreeing to electronic documents in EDMS of federal authorities can are used methods confirm action with electronic documents in which EDS is not used.

Composition of electronic documents, contact EDMS determined by the head of the authority on the basis of the recommendations of the Federal Archival Agency and in accordance with the list of documents, creation, storage and use of which may be carried out exclusively in the form of electronic documents [6].

Sending and receiving electronic documents made service office. Upon receipt of electronic documents service office authenticates "EDS".

It is important that electronic documents after their execution shall be kept in the prescribed manner with the authorities within the period provided for similar paper documents and recorded in the nomenclature of affairs.

Accounting unit of the electronic document is an electronic document that is registered in the authority EDMS.

After the deadline for storage of electronic files, by an act of allocating them to destruction, the alleged leader of federal authorities said electronic business (e-documents) must be destroyed.

With the introduction of electronic document and linked list of mandatory information on documents used to account for and retrieval of documents in authorities EDMS annexed to Regulation [2].

Authority EDMS must meet the requirements established by the Order of the Ministry of Communications and Mass Communications of the Russian Federation [7].

Currently, not all federal authorities prepared for the use of electronic documents and transition to electronic document, eliminating in some cases documents in paper [8, 9].

Of the 58 federal authorities at the end of 2013 48 - using EDMS, 7 - or planned introduction of EDMS them in the implementation phase, 3 - EDMS and had not planned introduction. This situation is reflected in the percentage of in Figure 2.

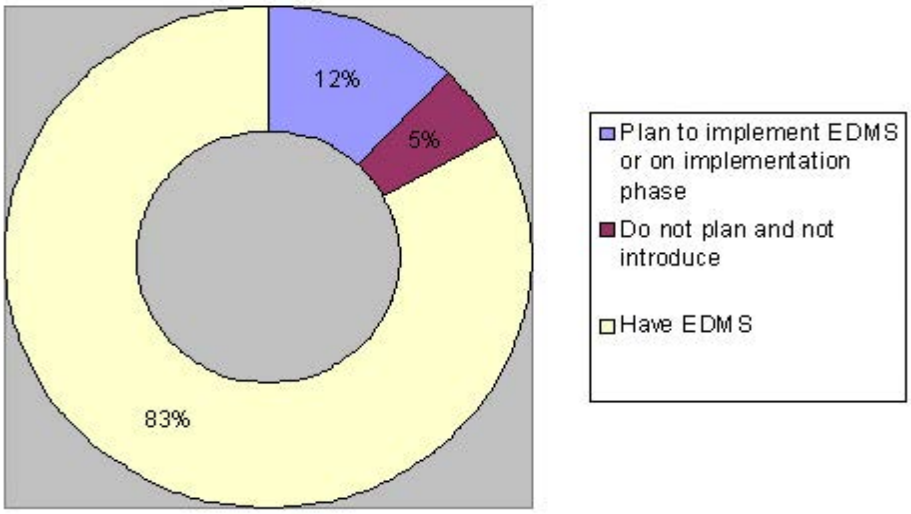

Figure 2 - Use of EDMS in the federal government

Basically EDMS serves the entire central apparatus of federal authorities, but in a few cases EDMS covers only a few structural units of the central office. However, full implementation of technologies working with electronic documents and electronic document on a national scale continues regulated relevant regulations [10, 11].

Interdepartmental workflow technology and e-government technology are a powerful source for formation of electronic content for government management [11].

The most promising architecture is federated. It implements a distributed (decentralized) repository using data replication as a mechanism for exchange of data between servers. This guarantees delivery of data and distributed conflict-processing documents.

Thus, conditions are provided for the creation of a centralized storage and support common content. Content combines organizational and administrative, legal and regulatory and library information. This provides the possibility of local generation, storage and support "local" content; rapid availability of content, which is common to the two organizational units. The result is the highest "integral" performance

One of the problems of the organization of interagency cooperation - ensuring accuracy of information exchanged between authorities.

Today outbound document registered in the EDMS sender organ and re-registered in the EDMS of organ, which is the recipient of a document. However, how to ensure the integrity of the database (DB) departmental EDMS? Attacker can to learn the administrative passwords and can delete or edit an entry in the database. The reliability of information guarantee in the system can be achieved by the introduction of a third party - the center of a unified IEW system. It might be a single national database, which would be supplied information on the documents recorded in the departmental EDMS. This database would not contain attachments (proper documents), but kept to the basic information about the documents. For such a system are presented, of course, very high requirements for uptime and performance, since the total document volume only federal authorities - the millions of documents per year.

Implementation of the unified system of electronic document management will reduce the financial cost of the development and creation of EDS. Unified system will ensure the safety of documents, increase efficiency and quality of management, openness and transparency of decision-making. When this happens reduce the number of forms, types and number of documents, and hence the scope of work with documents.

This requires the establishment at national level common principles of organization, harmonization and standardization of documentation, archival and record keeping services and a unified system of electronic document management in public administration. This system should allow for the lowest cost to optimize and streamline workflow in the transition to a paperless documentation.

Today, the market has a lot of EDMS used in the activities of government and commercial organizations. Harmonization and standardization is crucial to ensure their interaction and their compatibility with archival documents.

Given the steady increase in the volume of documents, it is necessary to develop regulatory framework of electronic document management in the following areas:

1. Determine the conditions under which the documents in government and local government can be created and accessed only in electronic form, without first creating a document on paper;
2. Regulation rules for the application of electronic signature or other means of verification activities with electronic documents at all stages of their life cycle, including consideration of electronic, electronic negotiation, signing, approval documents, as well as transfer to the archives.
3. Detailed regulation of the rules of storage of electronic documents in proceedings and archived organizations. Develop a set of internal regulations governing the work of EDMS, - the position of the electronic documents flow, the regulations of the EDMS, instructions for working with specific types of electronic documents.

It is important to form a uniform methodology for electronic document management and organization of work with documents on paper. At the same time, when you need a certain kind of interaction, you should have access to the means of interaction through simple and intuitive interface, adapted to different categories of people

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COLOURED PETRI NET USAGE FOR MODELING A BUSINESS TRANSACTION IN A SERVICE-ORIENTED ENVIRONMENT

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The paper describes business transaction's properties and possibilities to its construction with (web-)services as independent program units. For these purposes a service is represented as a finite set of operations that have post- and preconditions for invocation. Each operation can take a part in a service composition while each composition may be represented as an operation.

Keywords: business transaction, web-service, coloured Petri net, business process

One of the main directions of business information system development is a "process-awareness". Such systems are intended to link "information technology to business processes" [1]. By business process, we mean a set of work and incoming resources to achieve some values for consumer. Every process can be decomposed for number of nested processes and such decomposition may recursively last to the functional level of simple business functions.

In practice, there are some business processes that must be atomic, what means that they are executed completely or not at all. Especially it is necessary for an activity which involves several cooperating departments or enterprises, or for a process like, for example, «purchase and sale», where there is no way of partial execution [2]. In [2], [3], [4], [5] it is shown that such process is being executed with information system support can assume features of system transaction from the database theory – it consists of few operations which must be performed together or not at all. In our previous work [6] using definition from [4] the process is called a "business transaction" and we defined a business transaction as "consistent change in the state of a business relationship between two or more parties, where each party agrees to the change in state, and knows that the change was consistently implemented by all parties" [4].

Since the appearance of process aware information systems a lot of attempts to map database transaction models to business transactions had been being made (e.g. in [7], [8], [9]). However it was noticed that not every business transaction can meet ACID-properties (or satisfying all of this properties is not desirable). Distinctive properties of business transactions from database transaction we showed in [6]. These properties and characteristics let us reveal some similarity between their execution environment and, for example, service-oriented architecture of distributed system. In this case services become business transaction participants performing operations which in turn can be viewed as atomic or long-lived transactions. The service-oriented architecture (SOA) is based on a notion of service as an independent program unit with well-defined interface that provides loose coupling between software and external environment. In terms of a process-aware theory business can be considered as a service or a business transaction as a whole. Such attempts are is described, for example, in specifications BTP (Business Transaction Protocol [10]), WS-CAF (Web Services Composite Application Framework [11]), WS-TXM (Web Services Transaction Management [12]) and WS-Transaction/WS-Coordination [13], [14].

Currently, one of the challenges in the theory of SOA and service-oriented programing is (a) studying of approaches to simulate services and their compositions. Frequently it is

suggested to use Petri net language that has been deeply changed for last 30 years: lots of so called extensions appeared including different high-level, stochastic, timed or coloured nets.

Being an independent program system a service can provide a number of operations related each other with common purposes and domain. In software engineering the service is often embodied as the set of endpoints as entities that provide a set of operations by some address. Hence the service is represented as a set of operations too.

Let $CPN = (P, T, A, \Sigma, V, C, G, E, I)$ be a coloured Petri net that was defined in [11] and models services interaction. Than certain operation can be seen as $O = (t, P^o, A^o, \Sigma^o, V^o, C^o, G^o, E^o)$, where:

$t \in T$ is a certain Petri net transition.

$P^o \subseteq P$ is a set of input and output places such that $P^o = P_{in} \cup P_{out}$.

$P_{in} \subseteq P^o$ is a set of input places of transition t.

$P_{out} \subseteq P^o$ is a set of output places of transition t.

$A^o \subseteq A = P_{in} \times t \cup t \times P_{out}$ is a set of directed arcs, connecting transition t to output and input places. A_{in} and A_{out} are set of input and output arcs accordingly.

$\Sigma^o \subseteq \Sigma$ is a subset of colour sets (data types) that are used in coloured Petri net.

$V^o \subseteq V$ is a subset of typed variables that are used by operation.

$C^o: P^o \to \Sigma^o$ is a colour set function that assigns a colour set to each place.

G^o is a guard function that assigns a guard condition to operation such that: $Type[G^o(t)] = Bool$, i.e. the function returns Boolean;

E^o is an arc expression function that assigns to each arc $a \in A^o$ an arc expression such that $\forall a \in A^o : Type[E^o(a)] = C(p)_{ms}$, where p is a place connected to the arc a. E_{in} and E_{out} are set of functions over input and output arcs accordingly. And a set of all arc expressions can be viewed as $E^o = E_{in} \cup E_{out}$.

The only guard condition lets fire operation if input variables satisfy guard conditions. Colour set function $C: P^o \to \Sigma$ specifies strictly typified operation input and output that looks like service contract. For example, preconditions of an operation are expressed by colour set functions defining certain data types for input arcs and by arc expression functions defining input data transformation. I. e. precondition can be represented as $R_{in} = (P_{in}, A_{in}, E_{in}, \Sigma'_{in}, V'_{in}, C_{in})$. Postcondition is defined similarly to precondition: $R_{out} = (P_{out}, A_{out}, E_{out}, \Sigma'_{out}, V'_{out}, C_{out})$. So an operation can be expressed in terms of pre- and postconditions: $O = (t, R_{in}, R_{out}, G)$.

On the basis of Petri net definition, a service operation with inputs and outputs can be viewed as a Petri net like a directed graph. Let $CPN = (P, T, A, \Sigma, V, C, G, E, I)$ be coloured Petri net models services interaction and $O = (t, P^o, A', \Sigma', V', C, G, E^o)$ is a service operation. A composition of operations $o \in O$ is Petri net when $\forall o \in O\ \exists o' \in O: p \in P^o = p' \in P'^o$. At the same time operations can share places. Place p of operations O and O' is common between them of $p \in (P^o \cap P^{o'})$.

An interface of operation is a set of input and output places, i.g. P^o. Let's say that two operations O и O' are interface-equivalent when $C(\forall p^o \in P^o) = C(\forall p^{o\prime} \in P^{o'})$. Two operations O и O' are called interface-compatible where input places of O operation can be output places for O': $\forall p \in P^o_{in}, \forall p' \in P^{o'}_{out}: C(p) = C(p')$. Two operations O и O' are called partially interface-compatible where a subset of input places of one operation can be contained in set of output places of another operations: $P^o_{in} \cap P^{o''}_{out} \neq \emptyset$. Two operations O и O' are incompatible if $P^o_{in} \cap P^{o''}_{out} = \emptyset$.

A composition of operations O and O' is coloured Petri net $O \oplus O' = (T, P, A, \Sigma, V, C, G, E)$, where:

$T = (t^o, t^{o\prime})$.

$P = P^o \cup P^{o\prime}$, and $P = P^{\mathrm{o}}_{in} \cup P^{o'}_{out} \cup P^{o'}_{in} \cup P^{\mathrm{o}}_{out}$, $P_{in} = (P^{\mathrm{o}}_{in} \backslash P^{o'}_{out}) \cup (P^{o'}_{in} \backslash P^{\mathrm{o}}_{out})$, $P_{out} = (P^{\mathrm{o}}_{out} \backslash P^{o'}_{in}) \cup (P^{o'}_{out} \backslash P^{\mathrm{o}}_{in})$. For interface-compatible operations in this case: $P^{\mathrm{o}}_{in} = P^{o'}_{out}$: $P_{in} = P^{\mathrm{o}}_{in}$, $P_{out} = P^{\mathrm{o}\prime}_{out}$.

$A = A^o \cup A^{o\prime}$.

$\Sigma = \Sigma^o \cup \Sigma^{o\prime}$.

$C = \{ C^o, C^{o\prime}\}$.

$G = \{ G^o, G^{o\prime}\}$.

$E = \{ E^o, E^{o\prime}\}$.

A composition of a set of partially interface-compatible operations $O_1 \dots O_n$ and O' for all $n \geq 1$ is coloured Petri net: $\{O_1 \dots O_n\} \oplus O' = (T, P, A, \Sigma, V, C, G, E)$, where

$T = (t^{O1} \dots t^{On}, t^{O\prime})$.

$P = P^{o1} \cup \dots \cup P^{on} \cup P^{o\prime}$, and $P_{in} = (P^{\mathrm{o}}_{in} \backslash (P^{\mathrm{o1}}_{out} \cup \dots \cup P^{\mathrm{on}}_{out})) \cup ((P^{\mathrm{o1}}_{in} \cup \dots \cup P^{\mathrm{on}}_{in}) \backslash P^{\mathrm{o}}_{out})$, $P_{out} = (P^{\mathrm{o}}_{out} \backslash (P^{\mathrm{o1}}_{in} \cup \dots \cup P^{\mathrm{on}}_{in})) \cup ((P^{\mathrm{o1}}_{out} \cup \dots \cup P^{\mathrm{on}}_{out}) \backslash P^{\mathrm{o}}_{in})$.

and so on like above.

A service can be seen as a set of operations O united by common business logic. I can implement different function that can be included in different services compositions. The operation O can be seen as coloured Petri net CPN' containing nonempty set of transitions. All preconditions of O define the initial marking of CPN', while postconditions – the final marking. In the terms of notions listed above in [15] we proposed the concept of decomposition net what is intended to describe the process consisting of operations which in turn can be viewed as processes or services and decomposed to constituent elements. Decomposition net is slightly similar to hierarchical coloured Petri nets from [16].

It can be noted that expressing operation O in terms of coloured Petri net allows us to implement the concept of service loose coupling, since such net depends only on external environment over the interface P_o. And a representation of operation as a Petri net allows us realize recursive decomposition of this net into lower and lower level operations (nets) too. The opposite is true as well: a Petri net satisfying service operation conditions can be represented as some high-level function.

Let the business transaction is modeled by non-hierarchical coloured Petri nets. Than Petri net $BT = (P, T, A, \Sigma, V, C, G, E, I)$ can be viewed as business transaction is service-oriented environment if:

P is a finite set of business transaction's places. The set includes intermediate P_m and stable (final) places P_f such that $P = P_m \cup P_f$; stable places consist of input P_{in} and input P_{out} places, where $\bullet P_{in} = P_{out} \bullet = \emptyset$.

T is a finite set of operations and either of them (if it's not atomic, simple function) can be represented as Petri subnet and decomposed into independent net.

A is a finite set directed arcs such that $P \cap T = P \cap A = T \cap A = \emptyset$.

Σ is a finite set nonempty data types used in transaction.

G is a guard function that assigns a guard condition to each transition. Guard allows us, for example, to simulate operation failure.

I is an initialization function that assigns an initialization expression to each place $p \in P$ such that $\forall p \in P: Type[I(p)] = C(p)_{ms}$.

Markings are sets tokens in places. Marking defines a state of business transaction.

Initial marking M_0 is obtained by evaluating the initialization functions $M_0(p) = I(p)$ for all $p \in P$ and defines initial state for all business transaction participants.

Final markings M_f are obtained by execution of finite sequence steps Y, and $M_f \in \mathcal{R}(M_0)$, $\mathcal{R}(M_f) = \emptyset$.

The rest notions of business transaction are similarly described in coloured Petri net terms. So execution of business transaction is a multi-step transition from initial to final markings, where there are no possible transitions from the last. Each transition is an atomic operation which, as noted above, can be viewed as Petri net with some restrictions. In other words, if $BT = (P, T, A, \Sigma, V, C, G, E, I)$ meets service operation conditions it can be viewed as a service operation and be included in higher level composition as an atomic function.

The method mentioned here and in other our works allows us to model service interaction by coloured Petri net without restrictions related to service complexity. As distinct from approaches like service-nets proposed by Peter Massuthe in [17], workflow-nets by Will.M.P. van der Aalst [18] and simple Petri nets an introduced model has advantages:

Allows the viewing of business process as distributed interaction of loosely-coupled participants.

Allows the viewing of initial and final states of business transaction, to ensure it atomicity.

Allows the viewing of a service in terms of software development as a set of operations which, perhaps, even don't relate to each other.

In terms of coloured Petri net describes the key aspects of service-oriented programming: notion of interface, independent service, service composition which can be viewed from higher abstraction level as a single service and be included into composition with other services.

Operates on the basis of high-level coloured Petri net. It permits researches to use all advantages of this methodology for a simulation of dynamic systems.

Has no restriction with initial and final marking of particular places, that allows considering interaction as completed when final marking is reached not in final place.

Offered approach is used to evaluate reliability of business transaction in [19], [20] and to simulate it by CPN-tools [21].

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ROUTINIZATION OF BUSINESS PROCESSES OF MANAGEMENT: ANALYSIS OF THE STRATEGIC TOOLS

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The most popular twenty tools of strategic management were analyzed. The consistency of results obtained in the package STATISTICA 6 and from «Bain & Company» was questioned. The overall coherence of the results was concluded.

Keywords: **management tools, satisfaction, usage, frequency of requests.**

Today it is hard to imagine the economic development of organization without close connection with information technologies. Moreover, innovative technologies in the field of management are especially popular, they can significantly change the principles of the managers work and improve the quality of management [1-3]. Also in the past decade a

significant increase in the tool palette has been noticed, which can be used by decision-makers, in periods of change in the organization.

According to the well-known consulting company called «Bain & Company» [4] in 2013, Figire 1 shows 25 the most popular management tools, sorted by frequency of practical usage:

• Balanced Scorecard	• Decision Rights Tools	• Satisfaction and Loyalty Management
• Benchmarking	• Downsizing	• Scenario and Contingency Planning
• Big Data Analytics*	• Employee Engagement Surveys*	• Social Media Programs
• Business Process Reengineering	• Mergers and Acquisitions	• Strategic Alliances
• Change Management Programs	• Mission and Vision Statements	• Strategic Planning
• Complexity Reduction*	• Open Innovation	• Supply Chain Management
• Core Competencies	• Outsourcing	• Total Quality Management
• Customer Relationship Management	• Price Optimization Models	• Zero-based Budgeting*
• Customer Segmentation		

* Tool added to the survey in 2013

Fig. 1 25 the most popular management tools

The most popular twenty tools of strategic management of Russian business practices, presented in Figure 1, were analyzed in details: Change Management Programs, Balanced Scorecard, Core Competencies, Benchmarking, Customer Relationship Management, Business Process Reengineering, Customer Segmentation, Knowledge Management, Mergers and Acquisitions, Mission and Vision Statements, Open Innovation, Outsourcing, Price Optimization Models, Satisfaction and Loyalty Management, Scenario and Contingency Planning, Shared Service Centers, Strategic Alliances, Strategic Planning, Supply Chain Management and Total Quality Management.

Usage of strategic management tools popularity in business practices was evaluated by standard queries implemented in the search engine Google. The possibility of estimating the number of requests by keywords is implemented in specialized application Google Trends. For example, Fig. 2 shows the stat calls on request «Mission and Vision Statements».

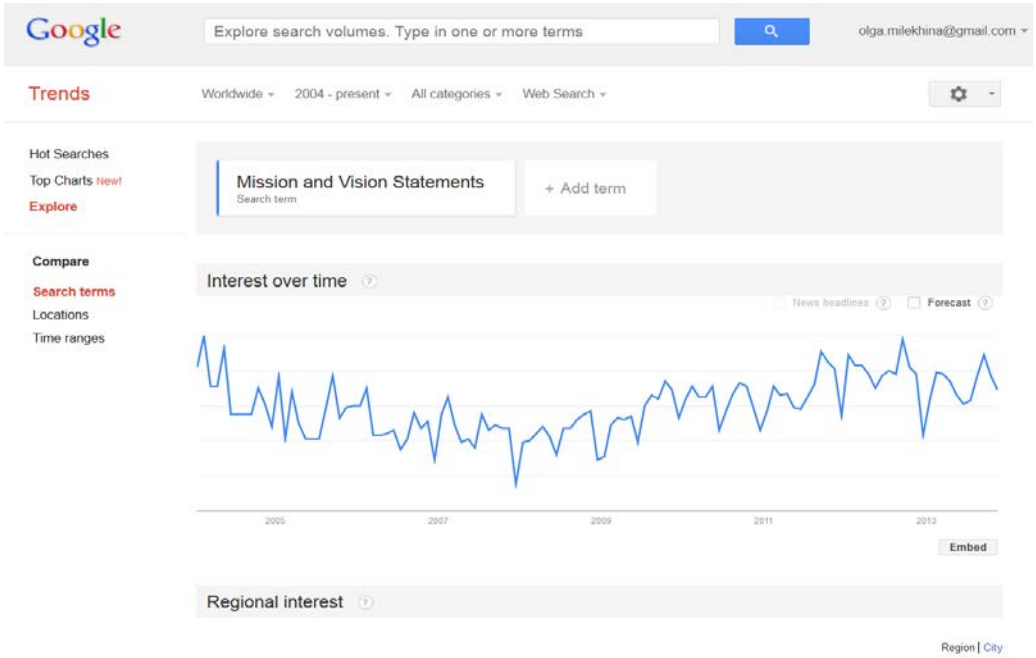

Fig. 2 Frequency of «Mission and Vision Statements» request

Likewise stat calls to the above instruments was obtained. Thus, the table of initial data in the packet STATISTICA 6 includes data on the Internet appeals to the above instruments since the 2004th for the year 2010 and is as follows (in Fig. 3 presents its passage):

1 Change Management Programs	2 Balanced Scorecard	3 Core Competencies	4 Benchmarking	5 Customer Relationship Management	6 Business Process Reengineering	7 Customer Segmentation	8 Knowledge Management	9 Mergers and Acquisitions	10 Mission and Vision Statements
62	53	72	73	78	47	74	60	0	77
61	63	77	79	78	55	73	55	0	80
59	70	64	82	76	62	76	69	49	75
57	62	57	79	81	70	79	56	47	67
53	53	47	73	85	49	82	42	45	65
48	49	45	70	77	42	52	40	40	63
44	47	44	68	60	39	43	39	35	62

Fig. 3 Initial data

Alignment of graphical display of results, presented by range diagram (eg, box and whisker plot) for all twenty management tools (see Fig. 4) organizes the results.

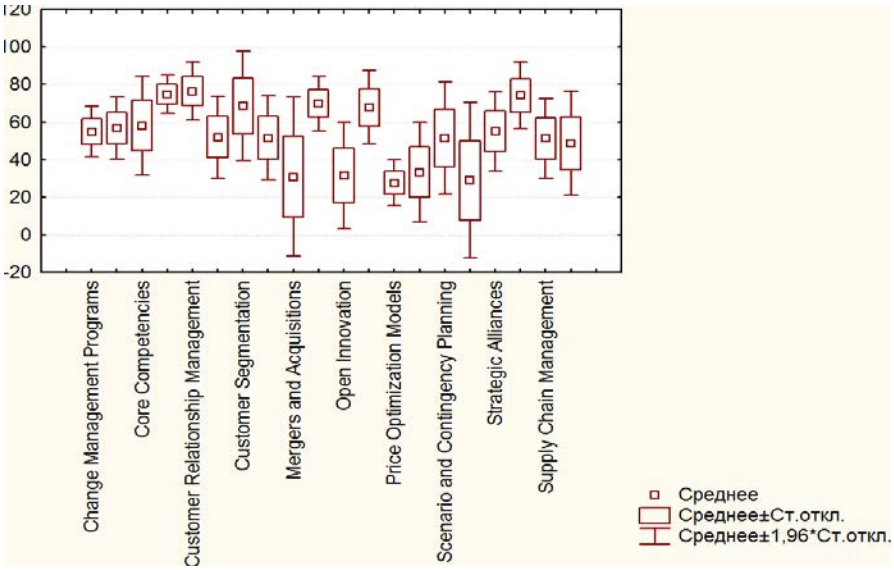

Fig.4 Box & whisker plot for 20 management tools

Interpretation of the data obtained in the course the study allows us to conclude that the average value of the sample for each instrument is very different and it is impossible to discern any trend. The minimum value of the mean minus 1.96 * standard deviation is observed in Mergers and Acquisitions and Shared Service Centers, and the maximum value of the mean plus 1.96 * standard deviation – in the Customer Segmentation. While the average number of requests to the search engine is above the average in the following seven tools: Core Competencies, Benchmarking, Customer Relationship Management, Customer Segmentation, Mission and Vision Statements, Outsourcing, Strategic Planning.

Consistency check of the results is carried in comparison to publicly reported data of consulting companies. Traditionally, one of the most prominent companies «Bain & Company» conducts a survey 10,000 leaders from 70 countries on the application of modern management techniques and assesses satisfaction with the results. The mean values of abscissa and ordinate axes held conventional boundaries separating the field into four unequal quadrants. The most popular tools are located on the quadrant II (usage and satisfaction are above the average in the current year). The last presented report gives the following assessment of usage of management tools and the level of satisfaction results (see Fig. 5).

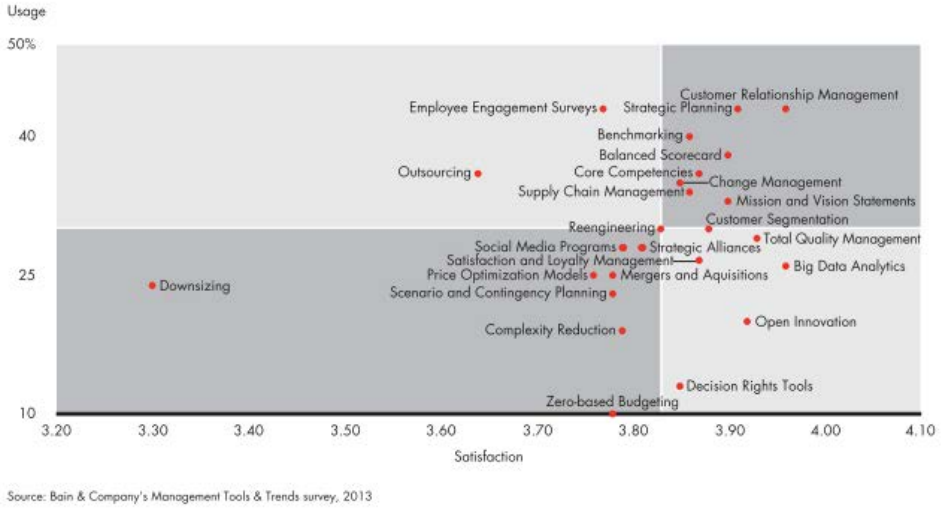

Fig. 5 Usage and satisfaction of management tools

Evaluate how the results obtained in the package STATISTICA 6 and data from «Bain & Company» (see Table 1) are consistent. "+" Sign in the table marked the tools, usability, satisfaction and frequency of treatment which is above average (for «Bain & Company» data it is in quadrant II).

Table 1 – Assessment of the results consistency

№	Management tool	Package STATISTICA 6	Bain & Company
1	Benchmarking	+	+, II
2	Customer Relationship Management	+	+, II
3	Customer Segmentation	+	+, II
4	Mission and Vision Statements	+	+, II
5	Outsourcing	+	–, III
6	Strategic Planning	+	+, II
7	Balanced Scorecard	–	+, II
8	Core Competencies	+	+, II
9	Change Management	–	+, II
10	Supply Chain Management	–	+, II

According to Table 1, the inconsistency of indicators obtained in the study, and «Bain & Company» data is not more than 30%. It is observed in the following management tools: Outsourcing - satisfaction is below average, Balanced Scorecard, Change Management and Supply Chain Management - frequency of requests is below average.

In general, we can conclude that there is the overall coherence of the results. In addition, it was revealed that a strategic management tool Big Data Analytics, which is based on modern information technologies allowing to process, organize and analyze the data according to the needs of management organization, Google Trends shows positive dynamics of interest in this tool since 2011 (see . Fig. 6).

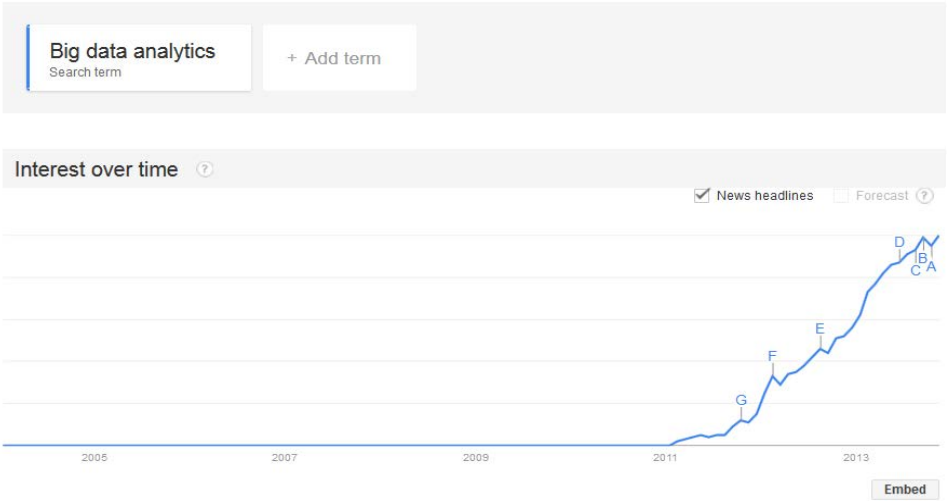

Fig. 6 Frequency of «Big data analytics» request

In addition, the features of the current situation related to the processes of globalization, business consolidation and gain of new forms of competition, changing strategies of competitors, the transformation of the economic paradigm of XX century, which led to the transition to marketing paradigm of economic development and predetermined socio-cultural changes in consumers, new patterns of life cycle of products, technologies, and exponentially

increasing information-richness of environment functioning of organizations made it almost impossible to use a single strategic management tool. Their combined use is largely possible to obtain a synergistic effect in the form of improved business efficiency, but its complexity, the gradual transformation of organizational structures and expanding the boundaries of the actual socio-economic systems by incorporating into it interested parties (stakeholders) do not allow to produce the impact of management decisions based solely on the data. In deciding, there is need for a rational combination of data (as a result of measurement) and knowledge [5] , as a result of generalization of previous experience of managing, for example, based on cloud computing. Such a convergence of knowledge, apparently, may underlie future strategic management tools that ensure the effectiveness and success of the organizations of the knowledge economy.

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INTELLIGENT SUPPORT OF DECISION MAKING IN WASTE MANAGEMENT USING CASE BASED REASONING AND ONTOLOGY

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In this paper a concept of intelligent support of decision making in waste management using knowledge-based approach is presented, which is a promising way to increase efficiency of waste management system in the cities. Analysis of the domain of waste management shows that the appropriate support of decision making can be implemented using contemporary technologies of artificial intelligent such as case based reasoning and ontology. In the paper the general scheme of the integration of this reasoning mechanism and ontology is suggested, as well the problems of knowledge and case representation are considered. Implementation of a prototype of intelligent decision support system in waste management on the base of case based reasoning and ontology is described.

Keywords: intelligent decision support system, case-based reasoning, ontology, waste management.

1. Introduction

The problem of increasing the efficiency of the waste management system in the cities is associated primarily with the introduction of innovative technologies for collection, transport, processing or disposal, managing and monitoring of waste materials. At the same time, it is especially important to have mechanisms for selection of the most efficient strategy for waste management and for comparative analysis of the appropriateness of implementing different technologies. The possible approach to solving this problem is to develop an intelligent

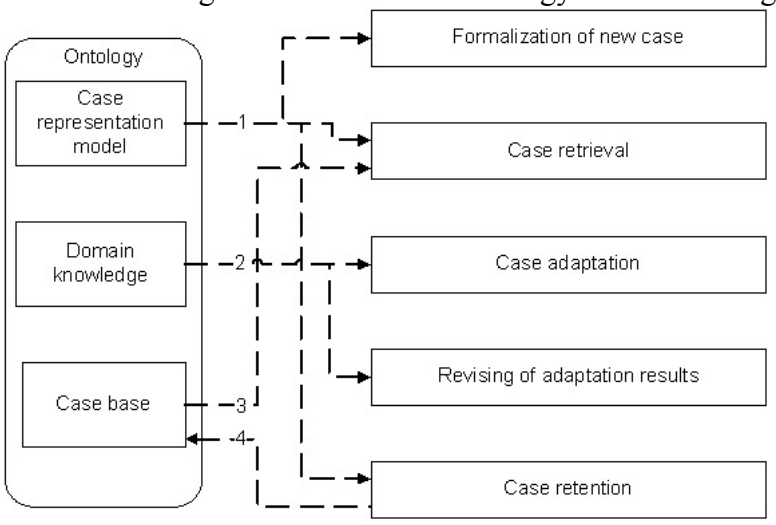
decision support system (IDSS) in waste management based on contemporary technologies of artificial intelligent. Analysis of the domain of waste management shows that the appropriate support of decision making can be implemented using case-based reasoning (CBR) and ontology. This paper is devoted to the development of concept of integration of this reasoning mechanism and ontology as well as the design and implementation of ontological knowledge base for IDSS in waste management in Volgograd.

2. Concept of integration of case based reasoning and ontology

The processes involved in CBR can be represented by a schematic cycle. Aamodt and Plaza (1994) [1] have described CBR typically as a cyclical process comprising the four REs: retrieve the most similar case(s); reuse the case(s) to attempt to solve the problem; revise the proposed solution if necessary, and retain the new solution as a part of a new case. A new problem is matched against cases in the case base and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused and tested for success. Unless the retrieved case is a close match the solution will probably have to be revised producing a new case that can be retained.

CBR approach is aimed for avoidance of first order knowledge use for problem solving, so support of CBR with ontology could be interpreted as disloyalty to grounding principles of CBR. But it is not completely correct and ontologies are used in various ways to make accurate and useful CBR possible. Generally case base does not comprise all knowledge required for correct solution of a new problem, but ontology allows to formalize domain knowledge and to reuse it for problem solving. Also ontology allows achieving semantic interoperability between case descriptions from different sources. Ontology could define framework for case description which allows simplifying case retrieving stage of CBR process. And finally it is recognized that general domain knowledge is necessary at the stages of case adaptation and revise.

In this paper the concept of integration of case based reasoning and ontology suggested in [2] was implemented for domain of waste management. According to this concept ontology describes general concepts and rules of domain, case representation model and contains case base. The general scheme of the integration of CBR and ontology is shown in Fig. 1.



1 – Description of case representation model
2 – Formalized domain knowledge
3 – Stored case
4 – New case

Fig. 1. Schema of the integration of CBR and ontology

Ontology as case representation model describes case as set of individuals and relations. Ontology as domain knowledge base describes domain knowledge as DL rules, using

procedures of knowledge inferring. Ontology as case base stores cases as a part of domain knowledge.

3. Case representation model

Structural objected-oriented model was selected as case representation model. This approach is useful at the concerned domain, because besides case it is necessary to have additional domain knowledge to obtain satisfactory results. Domain knowledge model also allows controlling quality of new cases which should be added to the case base, accordingly, it allows decreasing maintain costs substantially. The main disadvantage of this approach is a necessity of intense effort for development of domain knowledge model.

Case description consists of two main parts:

$$Case = \{P, S(P)\}, \quad (1)$$

where P – problem description (case index), S(P) – problem solution description.

Problem description consists of four descriptors which reflect the main aspects of case problem definition:

$$P = \{d_1, d_2, d_3, d_4\}, \quad (2)$$

where d_i – descriptor which describes one of case index aspects, it can be a complex structure;

d_1 – hazard class;

d_2 – amount of waste;

d_3 – aggregate state;

d_4 – type of waste;

Definition of solution consists of five descriptors:

$$S(P) = \{D_1, D_2, D_3, D_4, D_5\}, \quad (3)$$

where a descriptor D_i describes one of waste management methods which form the case solution. It can have a complex structure;

D_1 – transport of waste materials;

D_2 – collection of waste materials;

D_3 – processing of waste materials;

D_4 – disposal of waste materials;

D_5 – managing of waste materials.

Structure of case index is presented in Fig. 2. We picked out four main aspects of case index description which are presented in the figure. Users are able to emphasize the importance of any aspect(s) during case retrieval.

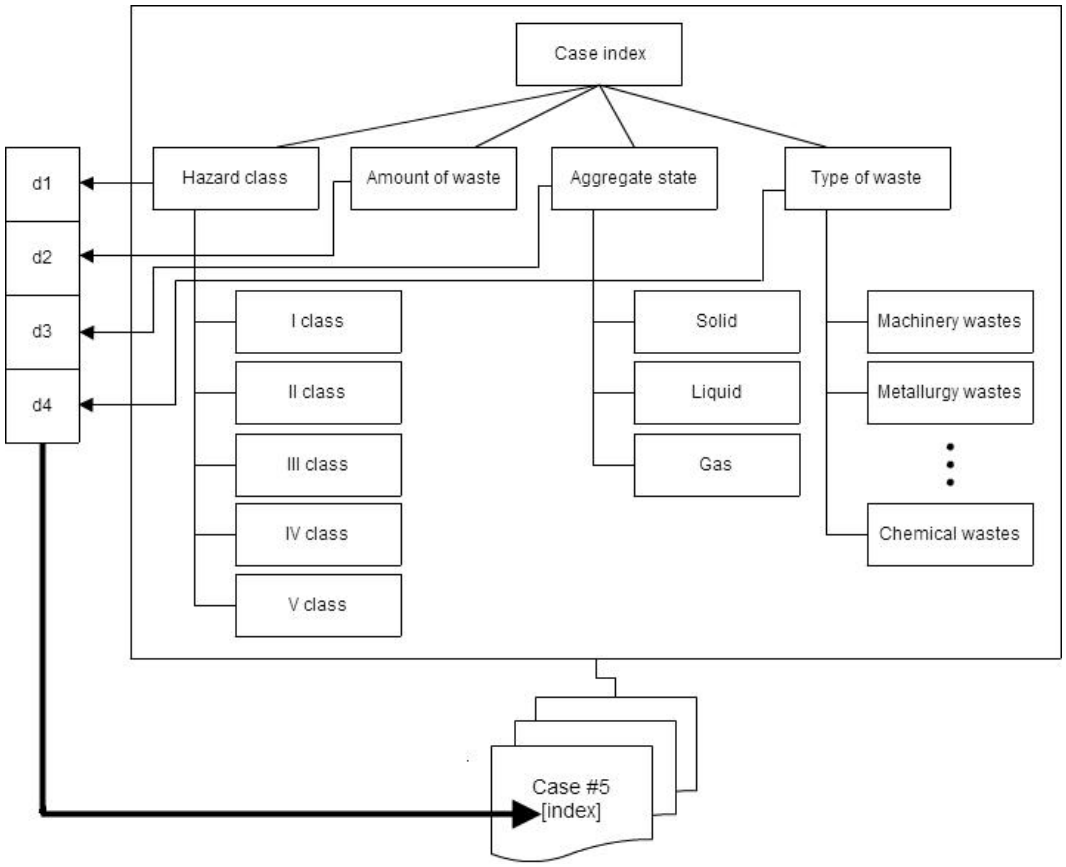


Fig. 2. Index structure

Structure of case solution is presented in Fig. 3.

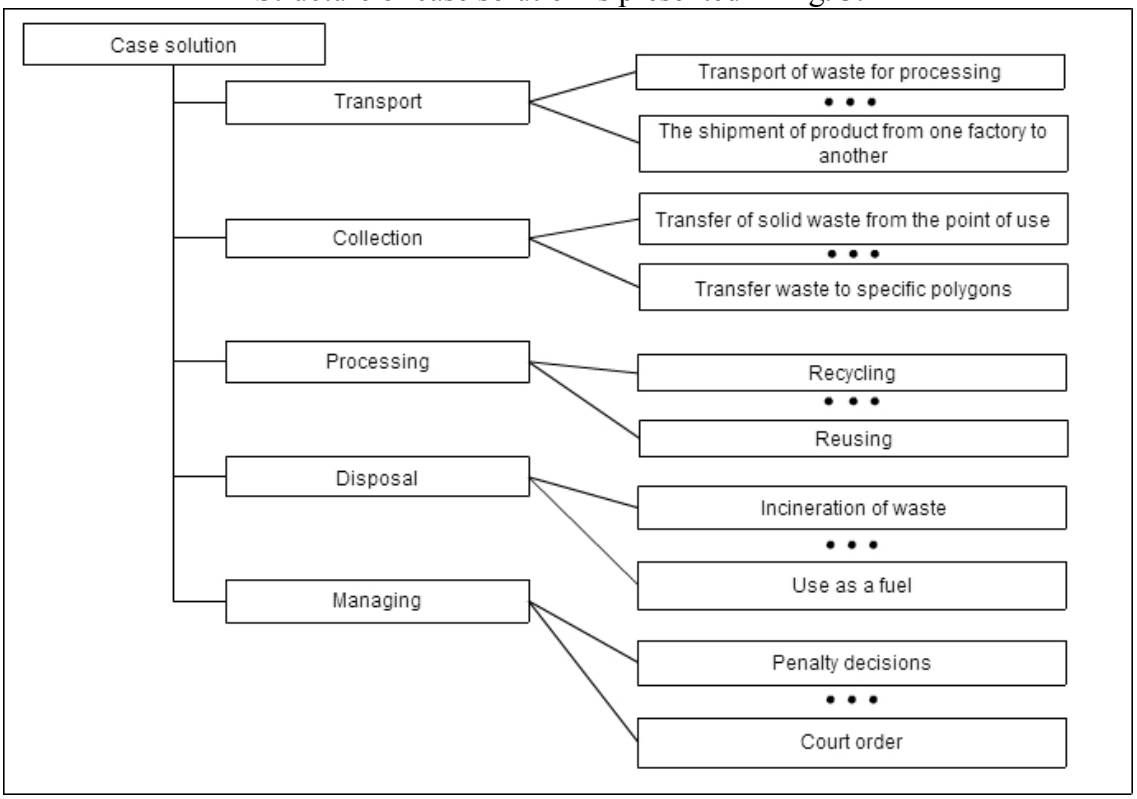


Fig. 3. Solution structure

So, on the top level case representation in ontology can be presented as follows:

1. Case name;
2. Case index;
2.1. Hazard class;
2.1.1. I hazard class;
2.1.2. II hazard class;
2.1.3. III hazard class;
2.1.4. IV hazard class;
2.2. Amount of waste;
2.3. Aggregate state;
2.3.1. Solid;
2.3.2. Liquid;
2.3.3. Gas;
2.4. Type of waste;
2.4.1. wood industry wastes;
2.4.2. feed industry wastes;
2.4.3. light industry wastes;
2.4.4. engineering industry wastes;
2.4.5. metallurgy wastes;
2.4.6. food industry wastes;
2.4.7. building materials industry wastes;
2.4.8. chemical industry wastes;
2.4.9. non-ferrous metallurgy wastes;
2.4.10. ferrous metallurgy wastes;
3. Case solution;
3.1. Transport;
3.1.1. Transport of wastes for processing;
3.1.2. Shipping to refinery;
3.1.3. Shipping to polygon for disposal;
3.2. Collection;
3.2.1. Transfer of waste to specific polygons;
3.2.2. Sorting, removal of other wastes;
3.3. Processing;
3.3.1. Board production;
3.3.2. Using as a fuel;
3.3.3. Incineration;
3.3.4. Mechanical destruction + sterilization;
3.3.5. Recovery at the site of use;
3.3.6. As a raw material for recycling or disposal;
3.3.7. Produce a heavy grade concrete;
3.4. Disposal;
3.4.1. Recycling;
3.4.2. Agricultural use in feed additives and fertilizers;
3.4.3. Regeneration;
3.4.4. Build temporary roads;
3.5. Managing;
3.5.1. Send for processing to specialized organizations;
3.5.2. Use of the facilities of engineering company;
3.5.3. In case of waste storing on the local area - vindictive damages;
3.5.4. In case of refusal of the penalty - subpoena;
3.5.5. Disposal is allowed only at special plants.

This tree defines top level of ontology hierarchy of classes, at the same time it defines case representation pattern. Case description is the set of individuals – instances of classes in ontology. For each leaf of presented tree there is one or more individuals in case description which defines one of aspects of case description. These individuals are mutually connected by object properties (two directional relations), so case description presents a fully connected graph and positioning of the nodes at the class hierarchy determines the case description.

In Fig. 4 the structure of case using ontology representation is depicted. Individuals which belong to a case index are marked with blue color and other ones which belong to solution are green-colored. Individuals are related by object properties. In Fig. 4 only one-directional properties are shown, but every relation in ontology has inverse relation, so it is possible to reach every node of the graph from every other node.

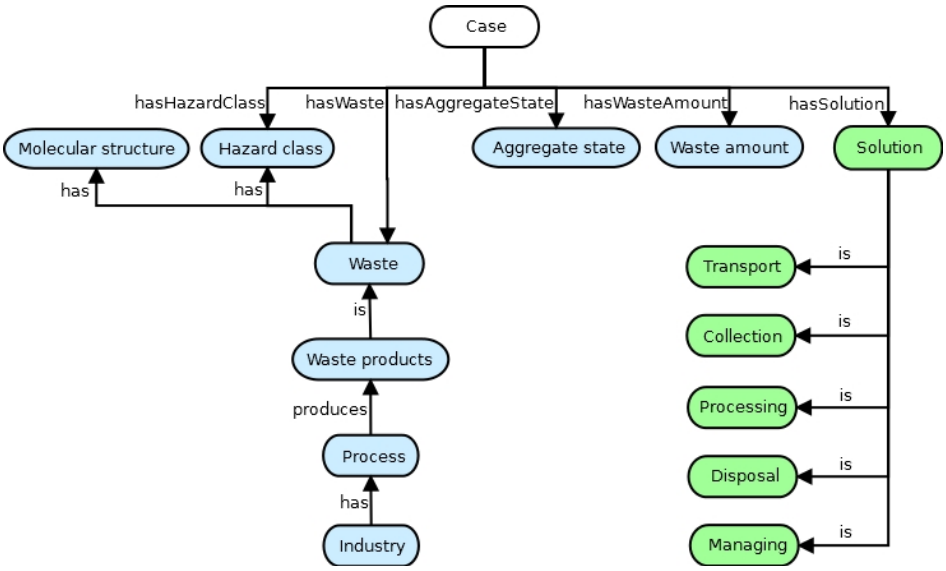


Fig. 4. Case structure using ontology representation

Thus the developed case representation model permits on the basis of ontological representation of domain knowledge to realize a CBR process effectively and to provide semantic interoperability of case based reasoning.

4. Reasoning mechanism

CBR cycle was implemented using CBR Framework jColibri 2.1 [3]. For computing the similarity between two objects the retrieve algorithm on the base of OntDeepBasic similarity metric [4] provided by jColibri was used.

For adaptation of solution to query case the generative adaptation was implemented, it allowed to use the formalized domain knowledge about dependencies between case solution and case description in the form of rules. Some examples of developed adaptation rules are given below:

(1) IF Type of waste = (“Papers“ OR “Books“ OR “Magazines“ OR “Wastepaper“) THEN Type of waste := “Natural pure wood sawdust“;

(2) IF Type of waste = (“Empty water bottles“ OR “Linoleum“ OR “Water pipe“ OR “Vinyl“ OR “Boat hull“) THEN Hazard class := “III_class“;

(3) IF Type of waste = (“Batteries“ OR “Cellphones“) THEN Type of waste:= “Spent lead-acid accumulators and reject“.

Consistency and completeness of case solution and need of new case retaining are revised at the last stages of CBR process. Consistency of case solution is revised using formalized description logic (DL) rules in ontology. Testing the new case solution is performed by implementation of standard procedures of knowledge inferring with ontology – “classify taxonomy” and “compute inferred types”. If an individual of a case solution is determined as instance of one of forbidden classes then case solution is treated as inconsistent. After inconsistence detection it’s possible to give an explanation of the probable cause of inconsistence and its description. Decision about new case retaining should be made by the user, but system can give an advice about possibility of retaining the new case. A new solved case can be saved into case base, if:

- solution of new case is consistent, or;
- the nearest case from case base has similarity measure less than some threshold.

In the first case, retaining the new case extends a positive experience of problem solving and refines the quality of CBR process. In the second case, retaining the new type of case (it's new because there are no similar cases in case base) allows to solve new types of problems and significantly refines quality of CBR process.

5. Intelligent decision support system in waste management

The considered integration concept and approaches to the case retrieval, adaptation, revising and retaining were realized in the research prototype of intelligent decision support system in waste management. The general architecture of the system is shown in Fig. 5.

The data storage was implemented in OWL format using framework Apache Jena [5] for management. This variant provides opportunities for efficient use of standard reasoning mechanisms of description logic (DL) for optimal implementation of CBR cycle.

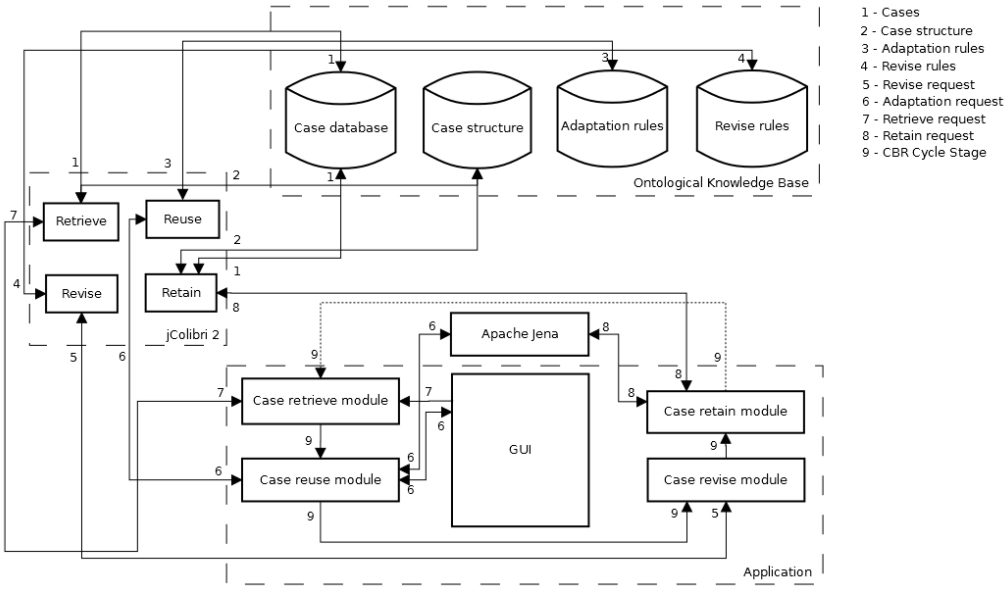


Fig. 5. The general architecture of IDSS

The ontological knowledge base was developed in Protégé 3.5 [6] and includes information on more than 60 industrial enterprises in Volgograd and waste produced by them [7,8]. The ontology contains 192 classes, 9 object properties, 27 data type properties, 29 annotation and 146 individuals. The case data base contains 30 cases which represent existing strategies of waste management on concrete industrial enterprises.

6. Summary

The ontological model for knowledge representation in domain of waste management was designed. In framework of the concept of CBR and ontology integration the ontological knowledge base and the case representation model on the basis of ontology were developed. The research prototype of intelligent decision support system in waste management was designed and implemented using the proposed approaches and models.

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DEVELOPING A MODEL FOR PROCESSING DATA FOR 'ASSESSMENT AND FORECASTING OF BUSINESS SUSTAINABILITY OF SECTORS OF NATIONAL ECONOMY (USING THE EXAMPLE OF AGRICULTURE)' PROJECT

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Abstract: a description is provided for the main stages in the model of data processing for assessment and forecasting of business sustainability of sectors of national economy (using the example of agriculture).

Keywords: data processing model, production sustainability, information need, external and internal sources of information, agriculture, and sectors of national economy.

The development of the model was divided into several stages displayed in Table 1.

Table 1. – Stages in the development of the model of processing data for assessing and forecasting production sustainability of agriculture

Stage No.	**Description of stage**	**Content of works**
Stage I	Creation of information need	Assessment and forecasting of the production sustainability of agriculture in the Rostov region
Stage II	Requirements to information sources	Search for and primary choose of required information. Primary indicators on the level of business entities. It is of importance to ensure coherence of the information obtained from different sources of planning, accounting, and non-accounting type
Stage III	Simulation	Development of a model for data processing
Stage IV	Feedback	Plausible scenarios:

		• Functioning • Adjustment • Development

We consider now the content of works pertaining to each stage in the development of the model.

1. Creation of information needs

At the first stage, the information needs of executive power agencies related to Russia's joining WTO were defined: they consist in necessity to develop an instrument for assessing production sustainability (hereafter PS) of business entities. Next, based on sustainability of business entities in the region, assessment of the region as a whole and forecast for the development of national agriculture industry are to be provided.

The 'production sustainability' category was defined as part of developing a theory of the sustainable development of socioeconomic systems. This theory was finally established after the 'concept of sustainable development' was adopted in 1992 at the UN Conference held in Rio-de-Janeiro. It is successfully implemented according to results of conference of the UN of "RIO+20" in 2012 [1,2].

The production sustainability of a business entity is characterized by its capacity to maintain production potential at a level that ensures excess over the production profitability threshold and distribute products (in this case agricultural products) and efficiently use the resources and factors that control development of a branch of national economy (development of the agricultural segment of economy) .

2. Requirements for sources of information

At the second stage, sources of information were analyzed. Required indicators and their sources were detailed; 28 primary indicators required for implementing the project were determined.

Sources of information were analyzed in two areas: at a level of business entities and a level of a municipal districts of the territorial subject of the Russian Federation (using the example of Rostov region). The composition and structure of agricultural objects are displayed in Fig. 1.

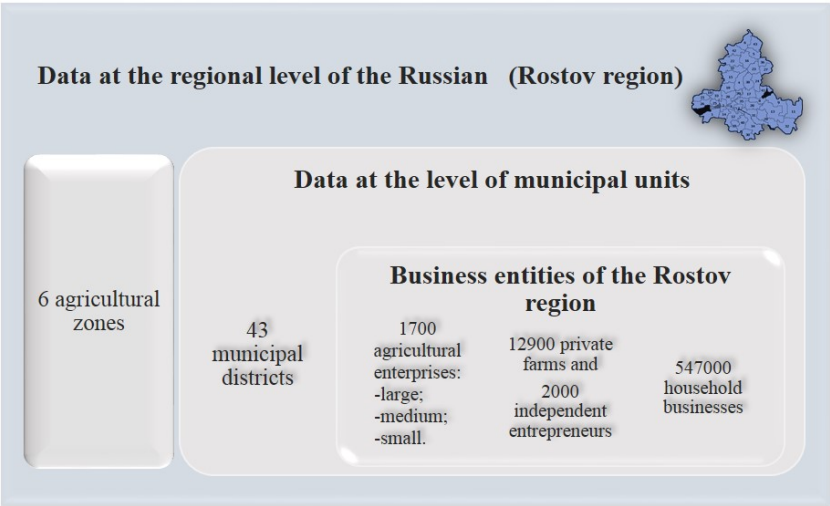


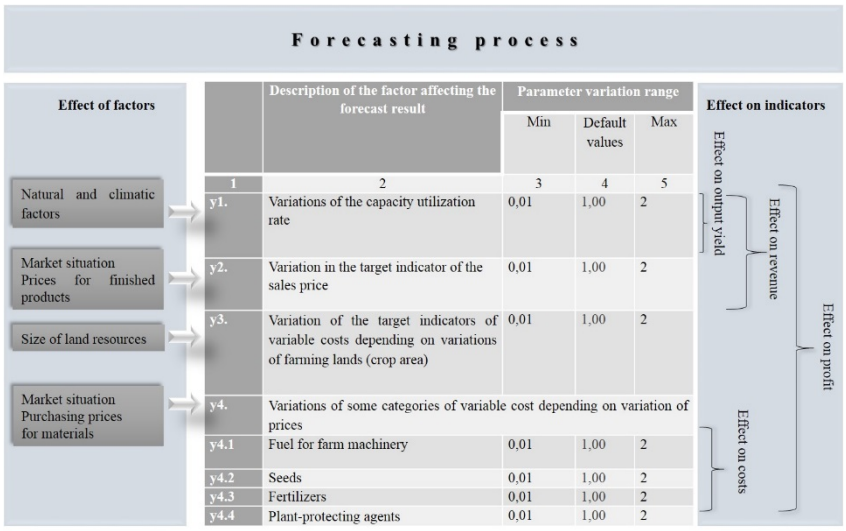
Figure 1. – Composition and structure of agricultural entities (using the example of Rostov region [3]

Sources of information were analyzed using a standard procedure applied to determine fulfillment of information needs of top managers [4].

The sources of information were identified to obtain data sets for the base model 'Assessment and forecasting of production sustainability.'

The following additional sources of information for assessing PS have been identified: the Regional National Statistics Service (Rostovstat) and the Ministry of Agriculture and Food Resources of Rostov region. One more source of information for modelling and forecasting PS and checking reliability of information was found, namely informational resources of agroindustrial complex (AIC), mass media, etc.

To fulfill the requirements for information sources, special attention should be paid to the information sources that enable one to perform factor analysis of the efficiency of using resources by business entities and forecast analytics. This refers to AIC information resources (portals http://zerno61.ru/) and AIC centers of market information (http://market-information.ru/). Mass media provide information about the trends in the development of AIC and statistical data on prices.



	Description of the factor affecting the forecast result	Parameter variation range		
		Min	Default values	Max
1	2	3	4	5
y1.	Variations of the capacity utilization rate	0,01	1,00	2
y2.	Variation in the target indicator of the sales price	0,01	1,00	2
y3.	Variation of the target indicators of variable costs depending on variations of farming lands (crop area)	0,01	1,00	2
y4.	Variations of some categories of variable cost depending on variation of prices			
y4.1	Fuel for farm machinery	0,01	1,00	2
y4.2	Seeds	0,01	1,00	2
y4.3	Fertilizers	0,01	1,00	2
y4.4	Plant-protecting agents	0,01	1,00	2

Figure 2. – Possibility of attraction of external sources for research of influence of factors on production sustainability using Big Data

3. Modelling

At the third stage, a model for processing data was developed.

This model contains some arguments of a calculable function (model), the values of which are used to compute sustainability. The model uses:

- 28 primary indicators;
- 24 calculated indicators for assessing PS;
- 34 calculated indicators for forecasting PS;
- 7 parameters used for modelling PS.

Object of the study: production, financial, and business activities of a business entity. Subject of the study: indicators that specify production sustainability.

Production sustainability was calculated on the basis of actual data covering last three years; for this purpose the developed mathematical model was used that is based on calculating mean geometrical average of three integral indicators:

- capacity utilization rate;
- yield on capital investments; and
- profitability [5].

The applied software facility for assessing production sustainability is the implementation of a parameterized mathematical model that enables to forecast variations of production sustainability depending, for example on such indicators as:

- output product;
- sales prices;
- production costs.

The parameters used in modelling are described in the 'Indicator variations' section. The variation of the 'capacity utilization rate' parameter affects the forecast crop capacity and the second parameter, the sales prices. Both of these parameters affect the forecasted revenue from sales of agricultural products. The third parameter, i. e. 'dependence of variable costs on variations of farming lands', and other indicators (prices for fuel and lubricants, seeds, plant-protecting agents, and fertilizers) affect the forecasted production costs of agricultural products. All of these indicators affect the financial balance (profit calculated as a difference between revenues and production costs.)

For example, if forecasted capacity utilization rate is increased (via calculating the average capacity utilization rate), the chart shows that the generalized production sustainability and integral indicators involved in calculating that sustainability increase as well.

5. Feedback

It is well known that results of modelling may either conform or not conform to reality.

To adjust the parameters of the model feedback is used (deviation of the modelled result from the actual one), and the process is often adjusted in a cyclic way.

From a top manager's perspective, the model may be assessed and subsequently activities and possible scenarios may be applied:

- functioning;
- adjustment;
- development.

As a result, a model will be created that adequately describes the system under consideration.

Testing the model apparently showed that a system for collecting and storing regional data is needed. The data, which are required for fulfilling information needs of government executive authorities, are to be collected using such external sources of data as industry information resources, industry centers of market information, and international statistical portal maintained by the UN, WTO. OECD that provide statistical information on export/import of industry products by years, social indicators, etc.

Therefore, creating a system for collecting and storing regional data required for fulfilling information needs of government executive authorities is to be the first step on the way to making management solutions in the environment of accelerating changes in business and the necessity to forecast the impacts of the decisions made.

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COMPUTATIONAL COMPLEXITY OF THE TASK ASSIGNMENT ALGORITHM IN PROJECT MANAGEMENT SYSTEM

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In this paper an approach to the determination of the task assignment algorithm time complexity is presented. The requirement of high and low computational complexity of the algorithm was formally defined for full and simplified version of the algorithm. In the conclusion author presents the results of the investigation.

Keywords: computational complexity, task assignment, algorithm complexity

Introduction

In previous works, the author investigated the methods and approaches for the problem of task assigning. (1) (2) In some ways, the problem under consideration is a special application of the job-shop problem. The problem under consideration the best fits the category of problems with deadlines, but computational complexity of task assignment algorithms, taking into account the deadlines is quite high - $O(n^3)$ (3), so it was decided to present the system as multi-step with a set of implementers with a set of characteristics. Thus, the algorithm of task assignment without taking into account the implementer's specialization, workload and other factors, with the number of implementers equal to two, in this case the complexity of the algorithm would be $O(n \log n)$ – it is the complexity of Johnson's algorithm, which is based on sorting. (4) Where n is the number of characteristics.

Johnson's algorithm uses the Bellman-Ford algorithm and Dijkstra's algorithm, implemented as subroutines. If the Dijkstra's algorithm nondecreasing priority queue is implemented as a Fibonacci heap, the running time of Johnson's is equal to $O(V^2 \log V + VE)$. With more simple implementation of a non-decreasing priority queue time becomes $O(VE \log V)$, but for sparse graphs this value in the asymptotic limit behaves better than the running time of the Floyd-Warshall.

Goals and objectives

Thus, the aim of this work is a definition of requirements on the maximum runtime of the algorithm.

The method of determining the maximum runtime is a formal definition of the asymptotic complexity of the algorithm. It is a function of workload dependency to the size of the input data. (5)

Minimum complexity

Suppose there is a stack where a task comes, a set of implementers with different characteristics, these characteristics - the result of the other algorithm. Physically, the stack can be represented as a table in the database, where tasks that are not marked with an identifier of implementer are not processed. The algorithm takes the oldest unprocessed task to make a decision. At this moment the part of the system logic that handles the task conditions begins to work, the conditions are such as compliance with employment performers or their specialization. If we presume that this part of logic works with complexity less than or equal to

$O(n \log n)$, the whole algorithm would have the complexity less than or equal to $O(n \log n)$, as I have shown above.

It was decided not to include in the basic algorithm of task assignment all the processes that are associated with the calculation of performance characteristics of implementer. All these processes are put in the category of auxiliary tasks. This decision is expedient in terms of building the system architecture, because it offloads the queue processing. All these auxiliary tasks should be processed on a pre-arranged schedule, and the result should be written into the database until the next update. (6)

Maximum complexity

Thus it is required to determine the maximum computational complexity of the task assignment algorithm. Minimum complexity for the algorithm not taking into account the characteristics of implementers, as we have seen above, is less than or equal to $O(n \log n)$.

Maximum computational complexity of the algorithm depends on the complexity of processing the implementers' characteristics set. The runtime of algorithm chosen will depend on the input data, in this case – the number of implementers (M) and their characteristics (C_m). The cardinality of the characteristics set won't be more than 10, but it is not so important now, since this value is constant and can be omitted in the final formulae. The same number of characteristics or less the task will have. Despite the fact that in some cases the time complexity function of the algorithm can be determined precisely, in most cases, it is meaningless to seek its exact value. The point is that with an increase of the input data size, the contribution of the constant factors that appear in the expression becomes extremely small. Algorithm, in its essence, should maximize a function with a finite number of variables.

As for characteristics, it is necessary to choose from all potential implementers those who are competent in solving this kind of tasks (resulting from its field, in other words – from tags). We should find the intersection of the problem tag set with every of the potential implementers' tag sets. This task have the complexity of $O(MC \log C)$, where C is the number of characteristics and M is the number of potential implementers. However, we must take the earlier estimate on the intersecting tags to compare performers on it and assign the task to the least busy of the best implementers – this function, in fact, can be reduced to sorting a list by a certain KPI. This process would run in logarithmic time. Thus for two implementers the algorithm should run in logarithmic time. In cases, where the number of implementers is more than two, it is most advantageous to reduce the problem to the case of two artists. This is so because such a problem is NP-hard and can be solved only for a longer time than$O(n \log n)$. The use of heuristics can reduce this time.

Conclusion

The author considered the approximate task assignment algorithm in order to determine the minimum and maximum complexity of the algorithm. Conclusions resulting from the study were also presented. The significance of this study is to determine the boundaries of the task assignment algorithm complexity, which should be complied with when developing. The result of this study will be used in the construction of project management system with automatic distribution of tasks.

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CRYPTOGRAPHIC PROTOCOL MAINTAINING CONFIDENTIALITY AND ANONYMITY IN SOCIAL NETWORKS

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In this paper we present a cryptographic framework to achieve a wide range of security properties in OSN, including access control, privacy of social relations, secrecy of resources, and anonymity of users.

We have developed a model of the authentication systems in social networks as a queuing network and algorithm simulation system authentication in social networks with anonymous users.

Keywords**:** social net, cryptography, protocol, authentication, digital signature.

Introduction

One of the central problems in the development of distributed systems is the design of cryptographic protocols that meet the desired functional requirements and meet the implementation of the security properties.

We introduce a cryptographic framework to achieve access control, privacy of social relations, secrecy of resources, and anonymity of users in social networks.

Cryptographic protocols that implement these methods use pseudonyms to hide user authentication, signatures on these pseudonyms establish social relations, and a combination of signature and zero-knowledge proofs constitute a system, in order to prove the existence of social relations without sacrificing user anonymity.

The team of scientists came to solving this problem, analyzing the results collected over the last few years.

As a result, it was found that the online social networks (OSN) have become a tool with which you can get in touch with people and participate in a number of activities related to social activities, such as information sharing, exchange of views, the organization of events and publication of advertisements.

Based on this, we concluded that the lack of access control mechanisms (for example, to restrict access to pictures, videos and messages on the wall) can lead to unpleasant consequences, for example, employers have the possibility of monitoring the personal lives of their employees.

In such conditions, the privacy of public relations is a fundamental property, in fact, as the anonymity of users.

Combining the concepts of anonymity forms of access control is crucial to ensure that certain documents could be read-only or available only certain persons, as opposed to users who are not.

Anonymity and confidentiality are also desirable in a variety of applications that can work with social networks such as content sharing and feedback reports.

1. Theoretical basis

2.1 Bilinear mapping

Bilinear mapping [1] of e-card elements from $G_1 \times G_2$ in target group G_T is bilinear. More precisely, for all values $G, H, x, и\, y$ the equality $e(x \cdot G, y \cdot H) = e(G, y \cdot H)^x = e(x \cdot G, H)^y = e(G, H)^{xy}$ takes place.

2.2 Digital signature scheme

We use a digital signature scheme recently proposed in the papers of Abe [2]. This scheme is highly effective, and the distinguishing characteristic of this signature scheme is that the check keys are in the message area.

Message space is the set of Diffie-Hellman: $DH = \{(i \cdot G, i \cdot H) | i \in Z_q\}$.

We are writing $x \in_R S$ to show that $x \in_R S$ is chosen uniformly at random from the set S.

At the message input $(M, N) = (m \cdot G, m \cdot H)$, each user chooses a public parameter $c, r \in_R Z_q$ and signature $sig = (A, C, D, R, S)$ where: $A := \frac{1}{s+c} \cdot (K + r \cdot T + M)$, $C := c \cdot F$ $D := c \cdot H, R := r \cdot G, S := r \cdot H$

It covers the following equality to verify the signature (A, C, D, R, S) in the message (M, N) $e(A, Y + D) = e(K + M, H) \cdot e(T, S)$ $e(C, H) = e(F, D), e(R, H) = e(G, S)$.

This digital signature scheme is resistant to forgery attacks and to the message that is the standard notion of security for digital signature schemes.

Proof system with zero knowledge proposed by Groth-Sahai and general scheme are very flexible. This is a multiplication in both G_1 and G_2 and equations pair products. We will use SXDH proof systems by Groth-Sahai [3,4,5].

Setting $gk = (p, G_1, G_2, G_T, e, P_1, P_2) \leftarrow G(1^k)$ defines a ring Z_p, modules Z_p $, G_1, G_2, G_T$, and scalar multiplication G_1 and G_2, and a pair of $e: G_1 \times G_2 \to G_T$. . Statement will consist of a set of equations or quadratic equations Z_p, multi-scalar equation productions G_1 or G_2, or pair equations products. Equations over exponential variables $x_1, \ldots, x_{m'}, y_1, \ldots, y_{n'} \in Z_p$.Group elements and variables $X_1, \ldots, X_m \in G_1$ and $Y_1, \ldots, Y_n \in G_2$. For each pairing product equation: $(\vec{A} \cdot \vec{Y})(\vec{X} \cdot \vec{B}) = t_T$. Soundness string: at the input gk of inverse transform $\sigma := (u_1, u_2, v_1, v_2)$where $u_2 = t_1 u_1$ и $v_2 = t_2 v_1$ and for random $t_1, t_2 \leftarrow Z_p$, at the input gk , and the proof system of equations σ and proof $\vec{X}, \vec{Y}, \vec{x}, \vec{y}$to group elements $\vec{X} \in G_1^m$ and the exponent variables $\vec{x} \in Z_p^{m'}$: $\vec{c} := \iota_1(\vec{X}) + R\vec{u}$ $\vec{c'} := \iota_1'(\vec{x}) + \vec{r}u_1$

, where R is $Ъ\, Mat_{m \times 2}(Z_p), \vec{r} \leftarrow Z_p^{m'}$. Commitment of group elements $\vec{Y} \in G_2^m$ and the exponent variables $\vec{y} \in Z_p^{n'}$; $\vec{d} := \iota_2(\vec{Y}) + S\vec{v}$, $\vec{d'} := \iota_2'(\vec{y}) + \vec{s}v_1$ where S, $\vec{s} \leftarrow Z_p^{n'}$.

For each equation the pair result $(A^{\rightarrow} \cdot \vec{Y})(\vec{X} \cdot \vec{B})(\vec{X} \cdot \Gamma \vec{Y}) = t_T$, $T \leftarrow Mat_{2\times 2}(Z_p)$, ; $\vec{\theta} = S \square \iota_1(\vec{A}) + S \square \Gamma \square \iota_1(\vec{X}) + T\vec{u}$.

1.3 Verification

At the input (gk, σ), is a set of equations and the proof $\vec{c}, \vec{d}, \vec{c}, \vec{d}, \left(\left[\vec{\pi}_i, \vec{\theta}_i\right]\right]_{i=1}^{N}$.

For each pairing product equation $(A^{\rightarrow} \cdot \vec{Y})(\vec{X} \cdot \vec{B})(\vec{X} \cdot \Gamma \vec{Y}) = t_T$ with proof $(\vec{\pi}, \vec{\theta})$ $\iota_1(\vec{A}) \blacksquare \vec{d} + \vec{c} \blacksquare \iota_2(\vec{B}) + \vec{c} \blacksquare \Gamma \vec{d} = \iota_T(t_T) + \vec{u} \blacksquare \vec{\pi} + \vec{\theta} \blacksquare \vec{v}$

In order to create proof for signature (A, C, D, R, S) on (M, N) proover should provide pairing product equation, equations dictated by the signature verification.. Later we will use C_A to mark a commitment A. $e(C_A, C_Y)e(C_A, C_D) = e(C_K, C_H)e(C_M, C_H)e(C_T, C_S)$, $e(C_C, C_H) = e(C_F, C_D), e(C_R, C_H) = e(C_G, C_S)$.

3. Implementation of basic protocols

A: $x_A \rightarrow Z_p, vk_A = (X_A, Y_A), X_A = G^{x_A}, Y_A = H^{x_A}$;

B: $x_B \rightarrow Z_p, vk_B = (X_B, Y_B), X_B = G^{x_B}, Y_B = H^{x_B}$. $ZK[stm; M_1, \ldots, M_m; N_1, \ldots, N_n]$ symbolically represent inactive zero-knowledge proof statements stm.

$M_1, \ldots, M_m$ - private values (these values are also called witnesses).

Private values are kept secret, while the public are accessible to all.

3.1 Registration protocol

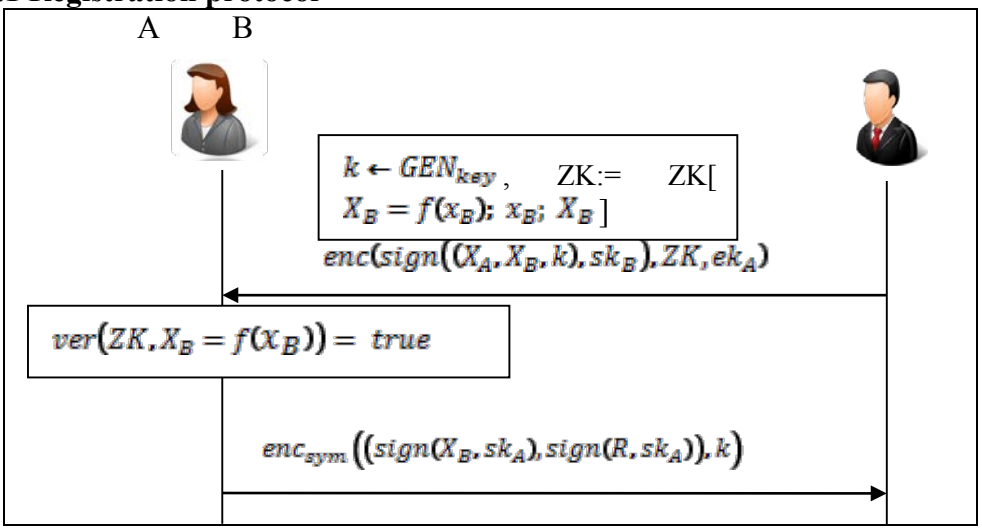

Figure 1. Registration protocol

Protocol shown in Fig. 1 shows a registration procedure by using the encryption.

There are two messages: interactive and non-interactive signature, zero-knowledge proof. Signature on X_A, X_B and the session key is used in the response. Zero-knowledge proof shows that the X_B is in the form of G^{x_B}. The person performing the inspection knows x_B and proof does not disclose x_B. **A** responds using encryption on X_B and a signature to the R, which describes the social relation, encryption prevents potential attacks on communications in order to learn the identity of the sender. Signatures used in the protocol to ensure the integrity of the registration request, and are used when responding to a message.

3.2 Protocol for getHandles, GetResource, putResource, GetFriends

On Fig. 2 B transmits zero-knowledge proof encrypted for A authentication. We offer three authentication mechanisms, namely authentication identity, authentication and anonymous authentication relationship. In the authentication B identifier in the signature proves knowledge from A on X_B to proof disclosed x_B .

With regard to the authentication signature proves knowledge from A to R, which is disclosed in the proof.

Anonymous authentication in signature proves knowledge of A, without revealing the signed message.

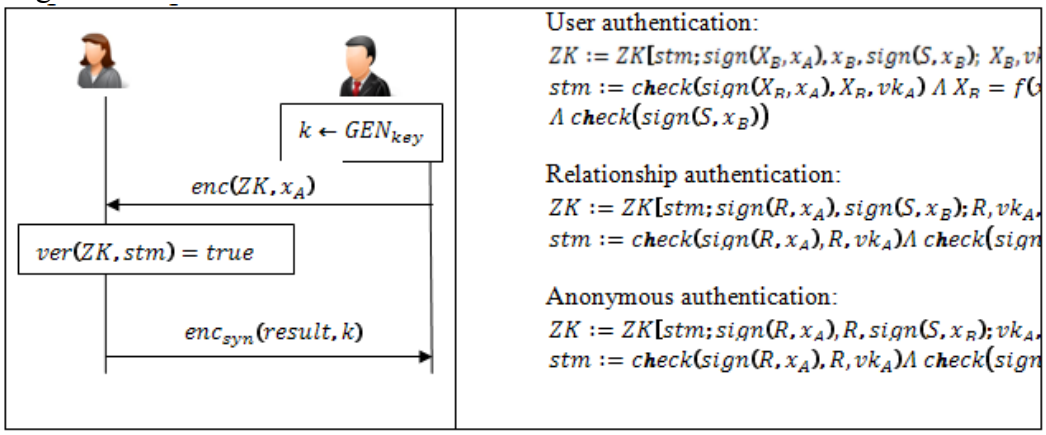

Figure 2. Protocol for getHandles, GetResource, putResource, GetFriends

4. Simulation modeling of authentication systems in social networks

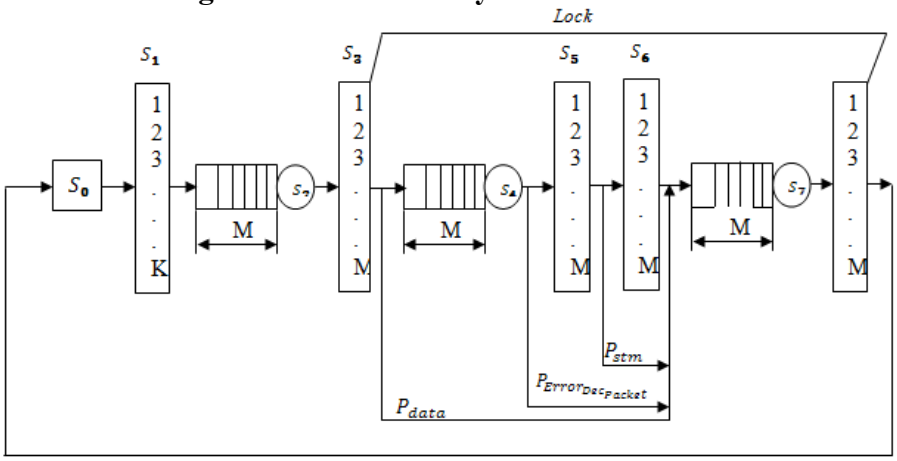

Figure 3. Protocols getHandles, getResource, putResource, getFriends authentication scheme in the form of queuing network

In this paper we use the approach by Lukyanov V.S. [6] to simulate authentication systems in social networks Protocols for getHandles, getResource, putResource, getFriends are shown in Figure 3:

S_0: service duration in center S_0 is distributed exponentially with the parameter λ . S_1 : center formalizing the module of TCP-operating system when establishing a connection. M-number of service channels, no queue. The center formalizes the module of TCP-operating system. It handled customer orders when establishing a connection with the implementation of the so-called three-step handshake. Service discipline is in the center of IS.

S_2- the main thread of the application server, the application retrieves from a queue on the establishment. Maximum queue length L is set to the center of the server application. Service discipline is in the center of FCFS-M/M/1.

S_5,S_6 - Centers S_5,S_6 have M service channels (server threads) and when beginning of the application service in $i-M$ channel of center S_5 it is considered busy until the

completion of service in $i-M$ channel S_8. Thus, the center channel is blocked. S_2, S_3 with IS discipline service nodes (serviced without delay). S_4 – center, cryptosystem module decrypts the packet S_4 with servicing discipline PS (processor sharing) and queue length M. S_5 - center formalizing work, check the value and extract the parameters required for authentication S_5 with IS discipline service nodes. S_6 - center formalizing work for pseudonym authentication or social relationships or anonymity S_6 with IS discipline service nodes. S_7 - center formalizing the module to extract a respond from memory allocated and generation EDS server S_7 response to service discipline PS (processor sharing) and queue length M.

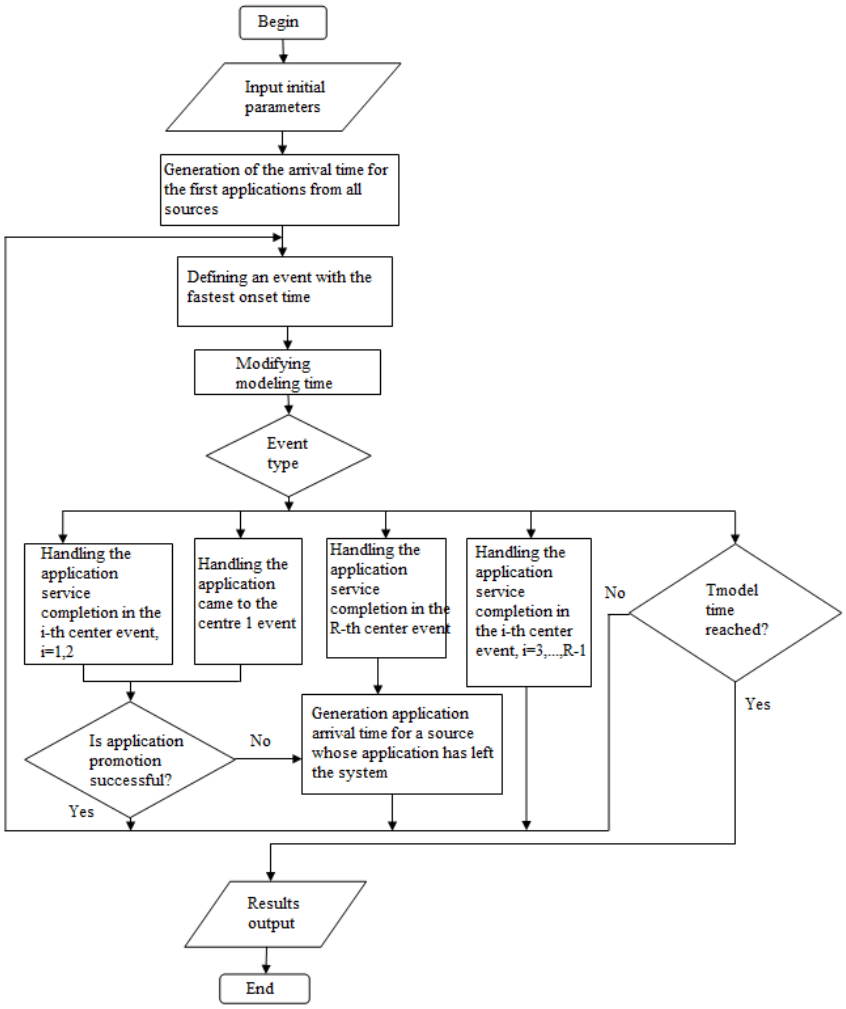

Fig. 4. Algorithm for authentication system simulation in social networks

Conclusion

Authentication systems modeling in social networks [7] have been carried out with a program developed in C # on the basis of the above simulation model algorithms.

Fig. 5 shows the results of its work. In the simulation, the following parameters of the system have been used. Maximum number of simultaneously open network connections: 30. Size of the application queue: 50**.** Maximum number of server threads $M = 200$. Duration of $RTT - 0.05$ s. Duration of authentication time: $S_6 - 0.0$ 12 s. Duration of test values and parameter extraction: $S_5 -$ 0,01 c.

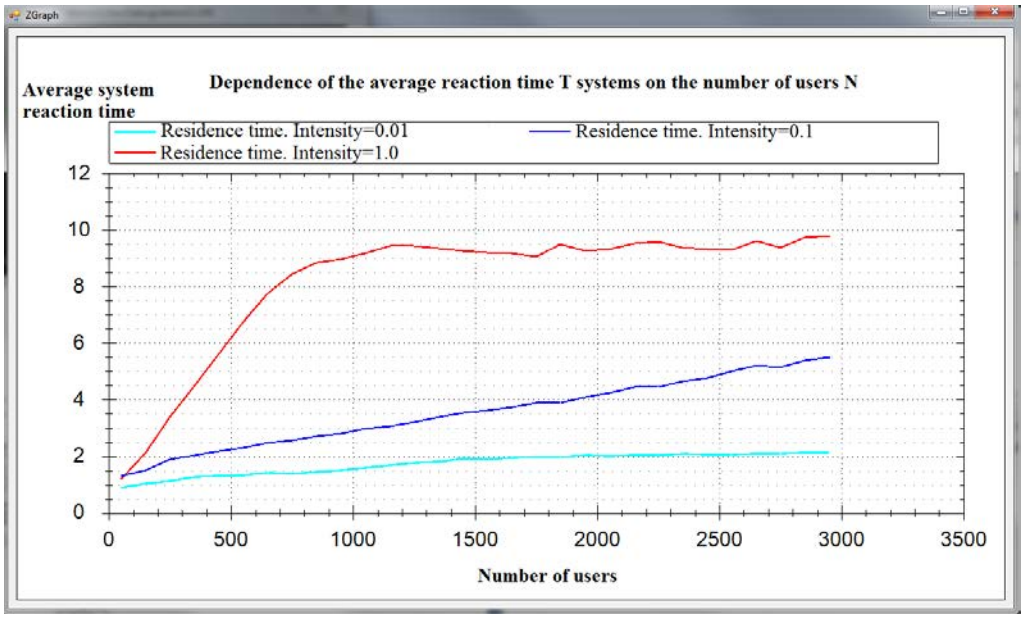

Fig 5. Dependence of the application average service time on the number of system users.

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THE LOGISTIC MANAGEMENT AT THE SPECIAL SEAPORT ECONOMIC AREAS

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Based on the consideration of the goods traffic forming tendency it has shown that the logistic management systems at the special seaport economic areas have to be aimed at container terminal maintenance in the first place. The specific peculiarities of such systems, among them freight management at "dry ports", feeding adjustment of various transport, the

custom control demands satisfaction have pointed out. The enumerated task solution with the using of complex logistic management system SOLVO.TOS has demonstrated.

Keywords: logistic management, special seaport economic area,

One of the most evident indicators of world economy globalization is a level of the international barter defining impact on formation of transport streams and logistic freights delivery chains. As before, the main transport ways are the sea communications providing not only communication between continents, but also allowing to achieve the minimum expenses on delivery large consignments of freight. Therefore the increase of shipping serves efficiency is a subject of constant attention of all parties interested in them.

In practice, the main indicators of sea transport efficiency are the speed and accuracy of cargo handling because the technology of ship loading and unloading defines turnover of vessels that means transportation cost. The revolutionary step in this direction was taken in the middle of the last century when the unified containers began to be used for transportation, allowing to organize intermodal freights delivery in uniform container with the minimum cost of its overload from one type of transport to another. At present about 90% of not loose freights all over the world are transported in containers that allow to reduce delivery time by 20 times in comparison with application of bulk loading. For a level assessment of using containers for transportation of different freight types the parameter called by coefficient of deliveries containerization, formed by division of goods mass transported in containers to the lump of deliveries is used. In table 1 on the basis of customs statistics the data on containerization of transportations are provided on separate groups of import and export goods in Russian Federation during 2011 [1]. From the table 1 the containerization share is directly proportional to the cost of transported goods and tends to growth in process of increasing in specific freights weight with higher value added.

The other direction of shipping improvement is an extension of overall performance of seaports, as places where there notes crossing the interests practically of all participants in merchandising process such as sellers, buyers, carriers, forwarding agents, and also public institutions providing this process: customs and boundary services, sanitary establishments, etc. The question is not only in productivity of port hoisting-and-transport equipment but also in improving of all port complexes as they serve as the peculiar "buffer" providing joining of diverse vehicles, belonging to sea, railway and motor transport, possessing essentially different characteristics on loading capacity, principles of loading, speed of a rolling stock turn, etc.

Thus, a contemporary seaport represents a set of a number of specialized terminals which are carrying out the corresponding freights processes (bulk, ripe, reeling, etc.) among which the most important place is being taken by the container terminal. Today such terminal represents the enterprise of transport infrastructure with large occupied space, providing reception, loading, unloading, storage, delivery of containers to the recipient, and also their overloads from one type of transport to another one for implementation of multimodal transportations.

There are three separate divisions within a port container terminal: the frontal terminal which is located along the mooring line and carrying out function of vessels cargo handling; the rear terminal or so-called "dry port", carrying out operations of loading and unloading and the their short-term storage; the remote terminal which is carrying out more extended in time logistic operations, such as storage, completing set of consignments of goods, small repairs of containers, etc. Similar division is connected with that practically all contemporary seaports were created in those days when commodity streams through them were too small. As ports always had served as incentive for developing social infrastructure round them, it led to territorial merging of ports with surrounding city building and at present it interferes into developing port economy, leading to its territorial crushing.

Table 1. The containerization level on separate groups of goods

Code of goods	Type of goods in containers, t	Weight in containers, t	Containerization coefficient	Total weight, t
Import				
07	Vegetables	829468	20,75	3997638
08	Fruit and nuts	2017577	33,84	5962892
09	Coffee and tea	268967	84,81	317155
10	Cereals	119454	17,9	667176
Export				
72	Ferrous metals	853715	2,43	35191939
74	Copper (products)	231486	39,4	587601
75	Nickel (products)	84941	42,22	201189
76	Aluminum (products)	1326014	33,34	3977394
78	Lead (products)	14471	16,83	85981
79	Zinc (products)	9583	15,18	63111

Territorial division of a port zone allows to solve arising crisis of development, however it demands conditions of another level of merchandising management in port. Furthermore this situation becomes complicated as seaports serve as a "gate" to country at implementing foreign economic activity. It means that customs control is subject not only the frontal terminal, but also rear and remote terminals. It is supposed to solve this problem by means of creation of the special port economic zones which have to provide simplification of importers and exporters interaction with customs service and to improve economic conditions of cross-border barter [2]. Anyway complication of port infrastructure demands increase of logistic processes informatization all over its territory and improves freight movement planning [3]. It is obvious that besides the solution of purely logistic management it has to provide coordination of interests of managing and controlling subjects accredited on the territory of the port [4], [5].

Thus, a contemporary port needs logistic control system including direct interaction management of different transport and information support of all interested parties of merchandising process concerning terms, structure and volumes of moving freights. Such system allows to regulate effectively vans, trucks and reloading equipment feeding to places of freight transfer and to coordinate consumer transport service in case of adjacent transportations on the basis of the current plan of a vessel arrival. It means that it is necessary to organize an uniform information environment for average and long-term planning, and also realization of synchronous interaction of different types of transport and participants of a transport corridor in the port.

Introduction of the similar logistic control system will lead to increasing volumes of seaport cargo handling; to increasing of merchandising processes efficiency; to reducing transport expenses and also to reducing cumulative investment loading due to increasing capital productivity of existing port infrastructure. For its successful realization in practice it is necessary to realize a number of organizational, methodical and other actions such as coordination of the reception and sending mass export and transit freight schedules; to increase number of container trains in a total turnover of rolling stock; to use electronic document flow, including with customs offices for the current control of moving freights and reducing

paperwork time; to use tracking means for looking after moving transport places, on territories of all involved port terminals and between them.

Relevance of a computerization increasing the problem of a cargo handling process in ports leads to that a large number of various information systems realizing both registration and tracking functions is used in the territory of all domestic ports at present. However, they weren't developed for the purpose of managing logistic and have, mainly, auxiliary appointment. Now it is some specialized systems of logistic management, mainly as ports differ at very large variety and it is difficult to develop basic functionality which could be duplicated and introduced as it happens in controlling systems of enterprises (ERP). Therefore, such systems are developed in relation to managing automation by the container terminals having the greatest number of common features and working with unified freights.

Among the container terminal control systems the two main types are used: the system of document flow support, raising efficiency of the traditional manual merchandising control, and the system of visualization and automation management [6]. The first one is urged to computerize account and drawing up documents in freight processing on the terminal. They usually don't support accounting function, but have locks for data transmission in specialized registration systems. Some of these systems have an additional option interfacing radio terminals for accounting containers directly on a platform.

Systems of visualization and automation give the chance to control the terminal operations in real time with using its model (placement of freights, workers and equipment; filling storage places, etc.) and to operate performed works in the automated mode according to the program set. Such systems in addition to problems of the current management carry out many other useful functions: to form port work statistics in a section of processed freights, terms of processing, equipment depreciation, etc., and also allow to estimate KPI on each operation of business processes carried out in the port. In tables 2 and 3 there presented the data of logistic control systems of both types applied in the Russian ports and the percent of their application, and in table 4 there presented the data on application of computer control systems in the largest domestic terminals.

Table 2. Systems of document flow of the Russian ports

Type of system	Conterra	Cargo Prime	SOLVO.DMS	Cosmos	Own development
Percent of application	27	18	18	10	27

Table 3. Systems of visualization and automation of the Russian ports

Type of system	SOLVO.CTMS	Cosmos	Is absent
Percent of application	45	10	45

The Conterra system is developed by the "Rolis" company being the part of the holding under the control of the National Container Company (NCC) with participation of JSC First Container Terminal (FCT) and JSC Seaport St. Petersburg and serves as the basic decision for all NCC container terminals.

SOLVO.DMS and SOLVO.CTMS systems are created by the domestic company "Solvo" and now besides Russia are operated in Ukraine in Ilyichevsk STP; in Estonia on the container terminal "Muuga", and also on the container terminal "Novoroslesexport".

The system "CargoPrime:Container terminal" is realized on the basis of a product "1C:Enterprise 8.0" by the franchisee of firm "1C" – the IT company "Dialogue" and is used on the container terminal "Moby-Dick" in Kronstadt, and also on the container terminal of the Kaliningrad Sea Trade Port (KSTP).

The Cosmos system created by the Belgian company "Cosmos N.V" also has the only installation in Russia on the container terminal of JSC "Petrolesport" in St. Petersburg. The

project was completed by installation of three of ten system modules: a module of document flow (CTCS), a module of a platform management (SPACE) and a module of reloading equipment management (TRAFIC).

The prevalence of Conterra system (almost third of the document flow system market for the container terminals – 27%) is explained by that of its owner – the NCC company that owns the essential share of the largest container terminals of Russia and Ukraine and uses its product for their computing. In process of growing a number of terminals and market volume capacity of such managing systems the ratio of a share of this system and the others one will be, apparently, in proportion to NCC share in the container terminal market. If the document flow systems are applied by all large container terminals, the automation of logistic operations, which is seen from tables 3 and 4, finds its place not everywhere. It is caused by that the document flow systems have, in fact, a "registration" nature generally recognized in many branches as the logistic management problem calls for more complicated decision. At present it is presented only two software solutions of the "Solvo" and "Cosmos" companies in the domestic market and they are used for 45% and 10% of number of the Russian container terminals respectively. Considering the fact that the "Cosmos" company has only one installation but not executed up to the end on the platform "Petrolesport" in the St. Petersburg seaport, software solutions of the "Solvo" company practically haven't got alternative.

Table 4. Usage of control systems in the Russian ports

Company, city	Document flow system	Visualization and automation system
JSC First Container Terminal, St. Petersburg	Conterra	SOLVO.CTMS
JSC Petrolesport, St. Petersburg	Cosmos	Cosmos
JSC Kaliningradsky STP, Kaliningrad	CargoPrime	isn't present
JSC Novorossiysky STP, Novorossiysk	SOLVO.DMS	SOLVO.CTMS
JSC Novoroseseksport, Novorossiysk	SOLVO.DMS	SOLVO.CTMS
Vladivostoksky container terminal LTD, Vladivostok	Own development	isn't present
JSC East Stevedoring Company, Nakhodka	Own development	SOLVO.CTMS

Now the "Solvo" company began installing its own systems on the Ust-Luga port container terminal.

The offered SOLVO.TOS system represents the complex automated control system for container terminals providing fulfilling reception, storage, processing and shipping containers on terminals, including supporting document flow of terminals in real time. The system is applied in the port logistic complexes, differed by difficult technological processes; multiterminal structure, difficult topology and zoning; application of polytypic park of reloading equipment and large volumes of freight transfer (from 100 thousand TEU). The purposes of this system used are: reducing of the vessel processing time and time of freights and containers staying on terminals in port; decreasing a number of the container shifts in a storage time; accelerating of the vehicle processing; raising paperwork quality; data transmitting according to existence and movement of containers to the terminal divisions and third-party users (to forwarding agents, agents, etc.); maintaining remote access mode for registration and a document transfer by contractors. The structure of the system is given in

figure 1.

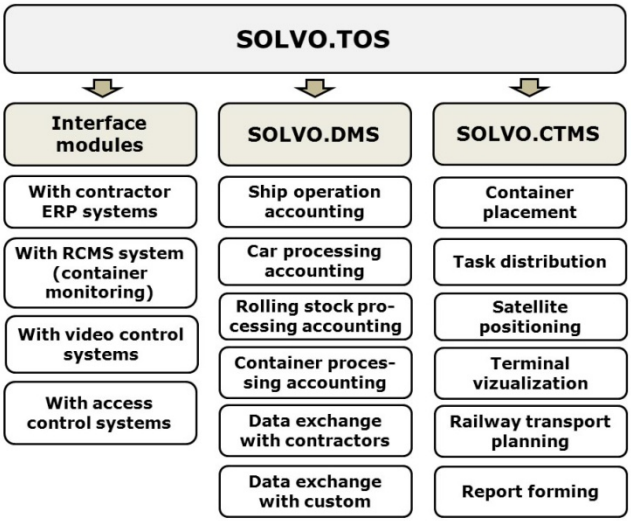

Figure 1. SOLVO.TOS system structure

Apparently from the provided scheme, the SOLVO.TOS system includes two main subsystems: a subsystem of the document flow management – SOLVO.DMS which automates functions of accounting, planning processing of container and vehicle, and visualization and automation subsystem – SOLVO.CTMS carrying out operational planning, realizing and controlling performance of all operations on terminals, and also a complex of the interface modules, allowing to establish connection with all necessary information systems which are in the territory of terminals. The main subsystems of SOLVO.DMS and SOLVO.CTMS interact with each other, carrying out planning container overloading, providing services in inquiry of clients on the basis of SOLVO.DMS and carrying out management by producing operation execution on terminals through SOLVO.CTMS. The results of execution are transferred to SOLVO.DMS for accounting of the performed works and rendered services. Such organization gives the chance due to using preliminary information on freight movement and cargo handling planning to take actual information on container finding, and optimizing their warehousing and the movement management via radio terminals of reloading equipment, accelerating processing of any type of transport, and also recording the history of container processing and receiving the protocols of reloading equipment operator work. The port warehouse capacity is increased from 5 to 20% (depending on terminal type), and labor productivity is on the average for 15–25%.

The subsystem SOLVO.DMS of document flow management has the modular structure that gives the chance to arrange its functions under the organizational and technological scheme of terminal functioning accepted in port, to consider the interaction specifics with contractors and means of transport ashore. The subsystem includes six modules:

- a module of planning and accounting ship operations, carrying out monthly and operational planning of vessel processing, and also inputting and loading data on containers on a vessel (for onboard system of the vessel accounting);
- a module of planning and accounting car processing, carrying out autovisit processing with containers and other freights, preliminary accrediting motor transportation enterprises and delivery drivers and generating a schedule (timeslots) for work with motor transport;
- a module of container processing accounting, fixing all operations with containers in port, namely processing of export direction containers; receiving containers from motor transport and railroad; loading of containers (including cross-docking); processing container booking; writing instructions for loading; actual loading containers on a vessel; processing import direction containers; forming consignments (cargo manifestos); registering container

reception and accounting release warrants; accounting bans and permissions to shipping; shipping containers on motor transport and on the railroad; unloading containers;

● a module of rolling stock processing accounting, accounting driving up and cleaning cars, planning and the accounting driving up process, and also preparing monthly plan of delivery by rail;

● a data exchange module with contractors, providing contractors data in the EDIFACT formats (CUSCAR, CODECO, COARRI, BAPLIE, etc.) and XML and giving a chance of automatic notification of the contractor about operations on the terminal by e-mail and the SMS;

● an interaction module with the customs service, allowing to carry out input of customs permissions and to make out customs reporting.

Functionality of the considered document flow control system of SOLVO.DMS generally corresponds to opportunities of other similar systems – Conterra, Cargo Prime, Cosmos and they solve together most actual problems to increase of the terminal overall performance. However, it is impossible to conform to constantly increasing quality requirements of rendering logistic services without organization of integrated management with use of specially developed control systems by container terminals – CTMS (Container Terminal Management System). Thanks to using data collection wireless terminals (RF terminals) and wireless communication of WI-FI, such automated systems operate processing of each arrived container, registering all its movements and cargo handling stages, including allocating an optimum place for its storage. It allows to carry out inventory in real time and to form all demanded reports on storage and movement of processed units.

Such system is the subsystem of container terminal visualization and automation of SOLVO.CTMS solving the following problems: managing of vessel loading and unloading and drawing up corresponding plans (cargo planning); managing motor and railway transport processing; organizing container processing at customs; placing containers on the terminal (place search) by various criteria; managing loading equipment work via the radio terminals installed on it; data processing satellite positioning system (GPS); fixing all events occurring on a terminal in real time; writing reports, etc. This subsystem also includes six modules:

● a module of container placing strategy, minimizing unproductive movements of containers by their rational placement in port terminal territory and grouping containers for rational using terminal area for container storage. All information on the container placing is displayed in the form of model representing a view of container terminal from above with opportunities of scaling the terminal zone, places of storage and location of equipment (figure 2). At request of data on a container storage place the system gives the list of the containers which were stored in it and detailed information on them (unique number, ISO, type, length, weight, the direction – loading on transport or unloading on terminal, data on freight and its owner, and transport information);

● a module of automatic distribution task, carrying out the processing of data arriving from operator radio terminals and transferring information in planning system in real time;

● a module of satellite positioning processing data from GPS receivers and systems of RTG (KONE, Kalmar) positioning (movement, captures and lowering of containers), documents on reloading equipment movements, and analysis on reloading equipment for the chosen period in the past;

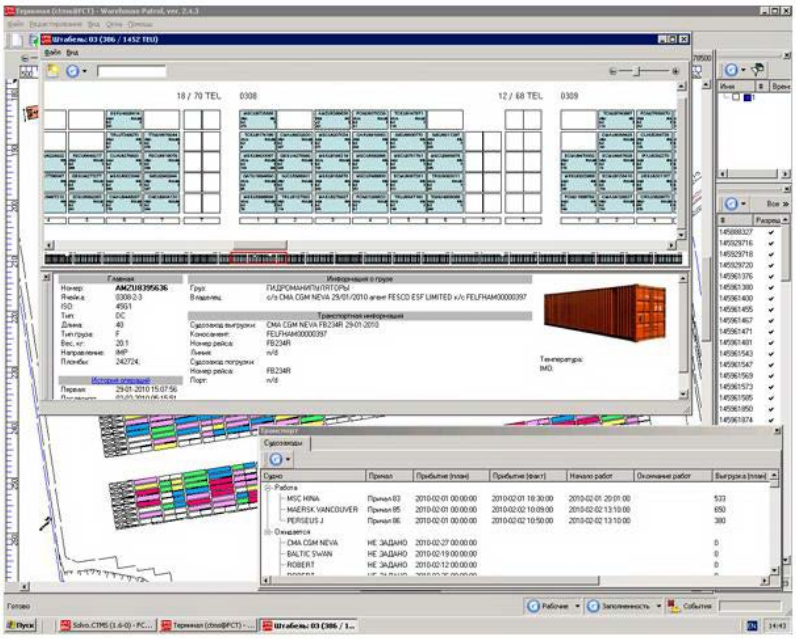

Figure 2. Screenshot of container placement module information

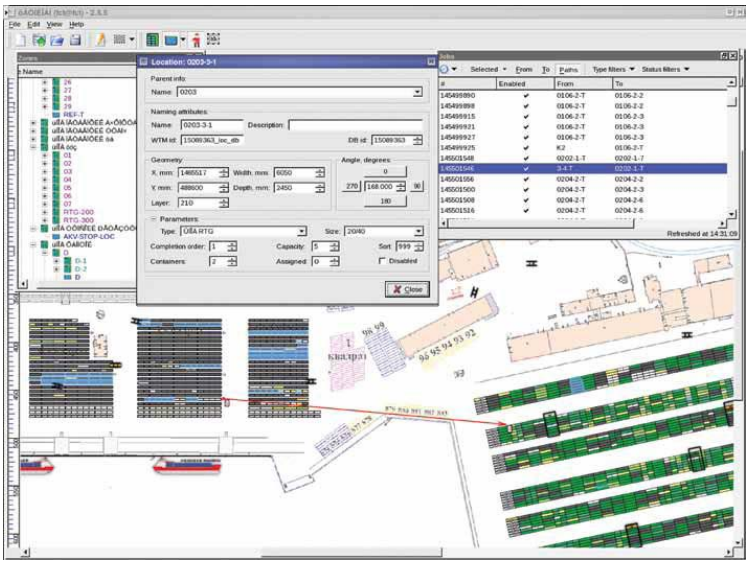

Figure 3. Screenshot of information of port work process visualization module

● a module of visualizing port work process allowing to receive visual display of container terminal fronts to carry out viewing of storage zones in the integrated look, to edit terminal topology, to display placement of container groups by set criteria, to display movements of loaders and a trajectory of reloading equipment movement (in presence of satellite positioning module), as shown in figure 3;

● a module of a train loading automatic schedule, making control of reception and accounting of containers on railway platforms, managing container loading and unloading on railway transport and forming working zones on processing of railway transport. As result of operation of the module the lists of container loading by various criteria have been created as shown in figure 4;

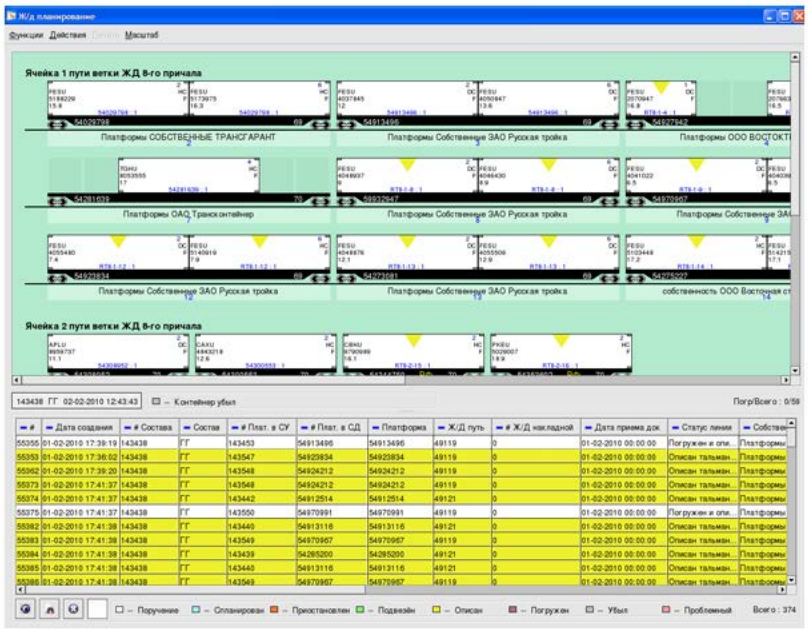

Figure 4. Screenshot of train load planning

● a module of reports and operation history viewing, intended for generation of necessary reporting documents (including independent), used in the terminal technological process. The list of reports and export format (MS Word, by Excel, etc.) are agreed with the customer and if necessary are transferred by means of e-mail.

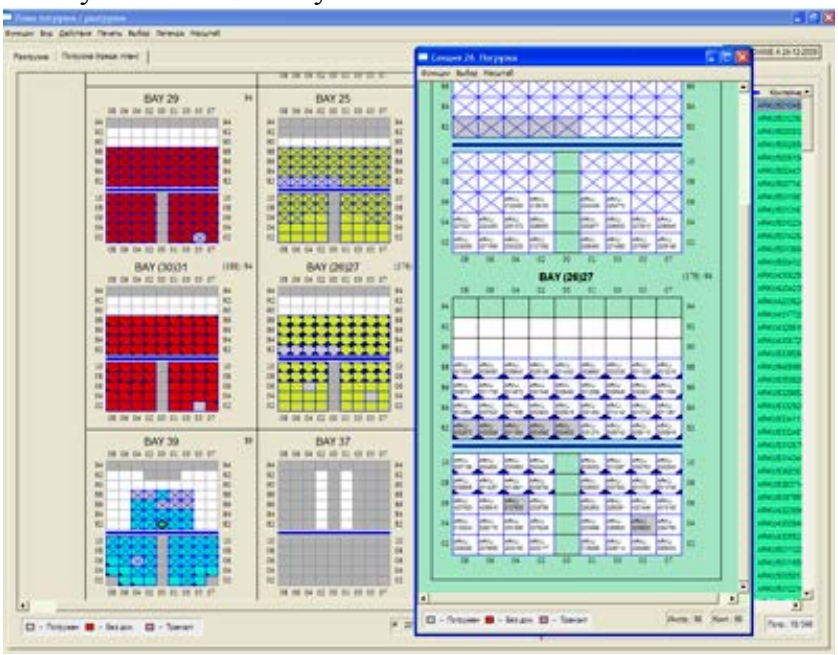

Figure 5. Screenshot of the cargo planning module information

In addition to SOLVO.TOS system the cargo planning module was developed which analyzes different options of container placement on a vessel and chooses the plan of the most rational use of cargo rooms taking into account a stability of the vessel. The module doesn't serve for an actual ship cargo plan development, that belongs to functions of the cargo master assistant, and more likely maintains a copy of vessel loading scheme, in its turn to build the optimum container movement process from storage places and an order of loading on the vessel. The option of vessel loading, displayed in the cargo planning module, is shown in figure 5.

Operating experience of SOLVO.TOS system showed that its utilization increases the terminal capacity on average by 5-10%, increasing the run of empty equipment on average to 50%, increases productivity of loading equipment for 20-25% and brings at least to growth of freight transfer volume approximately for 30%.

Thus, practically all problems of a special port economic zone management (except for investment) can be solved be means of the complex logistic management system. The only domestic software product of such class is the SOLVO.TOS system which comprises the features of electronic document flow system and visualization of logistic operations and has got a connection with wide range of other information systems used in port. It is the opportunity that allows besides the solution of all logistic tasks stated above to reach essentially higer level of client service (for example, combination of information on container movements on the port territory with record of surveillance cameras allows to track them and to reveal possible insured events).

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QUESTIONS OF THE ORGANIZATION OF MEDICAL EXAMINATION OF THE POPULATION USING INDUSTRIAL CONTROL SYSTEM (ICS)

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The article examines the use of industrial control system of preventive examinations of the population. The main tasks of planning and analysis of medical and preventive care using data centers.

Keywords : industrial control system, disease prevention .

Industrial systems for organizing and conducting preventive medical examinations of the population , are divided arbitrarily into three groups:

- Automated planning and accounting dispensary population administrative territory (ACS clinical examination);

- Industrial system of preventive medical examinations organized groups of the population with the widespread use of medical equipment , conjugated with minicomputers providing issuing medical certificates ;

- Automated comprehensive medical examinations of population using standard tools of research results and medical history and carrying out surveys on the basis of application of micro -computers and other types of computer identification of disease profiles

Research methods. The main tasks of industrial systems for the organization and conduct of preventive medical examinations of the population are: automation of data processing laboratory , electrocardiographic , biochemical, anthropometric , fluorography and anamnestic research , formation of information about each patient as a result of medical examinations physician , surgeon , neurologist , otolaryngologist , ophthalmologist , radiologist , dentist , dermatology and venereal diseases obstetrician-gynecologist , establishing medical diagnoses of diseases by methods of machine - diagnosis.

Research results. " ICS clinical examination " is a complex task of planning and analysis subsystem preventive and curative health care ASU territory and must be operated on the basis of a regional medical center computing . Used technology data center using conceptual specifications [1-3]. . The main objectives of "ACS clinical examination " include planning , accounting, statistical analysis and reporting of clinical examination of the population living in the administrative territory (a region, a big city). Industrial system of medical preventive examinations of the population - is created in the form of an extensive network of terminals, automated medical instruments and devices with microprocessors , paired with a network of workstations doctors. Application ACS allows patients to identify the main profile of the disease .

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SPECIFICITY IMPLEMENTATION OF INTELLIGENT MANAGEMENT IN THE RUSSIAN CITIES

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The article is described the scheme of intelligent management system of the city, which is built with the experience of introduction of information and communication technologies and specifics of management in Russian cities. The author formulated requirements for the proposed intelligent system, and described the organizational and economic conditions and risks of its implementation.

Keywords: intelligent city, intelligent management system, urban infrastructure, information technologies.

In modern world with the advent of new requirements for urban development and ensure their competitiveness, the concept “intelligent city” took shape. It captures the increased role of human capital and the growing importance of information technology in an urban environment. In the “intelligent city” the primary role is given to information,

communication, technological developments. The concept is an intelligent management system of a city that integrates the management of municipal services industry into a single information center. The heart of this complex includes intelligent information network designed to improve the functioning of the various spheres of the city's life, as well as stimulate their qualitative transformation. The process of implementation of the technology in existing cities involves a complete renovation and modernization of the infrastructure to transform the entire management system, service and safety.

As of 2012 there were about 143 projects of "intelligent city" different levels of completeness (in North America - 35 projects in South America - 11 - in Europe , 47 in Asia - 40 , 10 - in the Middle East and Africa) [1]. There is the practice of intelligent cities in Russia too. Thus, a plan to create "intelligent cities" was announced in Moscow, Kazan and Skolkovo. Separate elements of intelligent control implemented in Yekaterinburg, Samara. The most exponential example is Moscow, where it has been successfully implemented the portal of state and municipal services in the city of Moscow "Convenient city", "Moscow. Our city. Manage together", "Open City. Open data portal", "Safe City"," Responsive city. Single medical information -analytical system ." The creation and development of the "intelligent city" Moscow is in the state program of the city of Moscow "Information City". In Moscow engineering innovations combine information technology and technical development with the management center used to control the housing and communal services and traffic.

Specificity of implementation the intelligent management system in Russian cities consists in the salient features of their development. Creating the intelligent management system in existing cities is complicated by the problem of wear communications infrastructure, which requires substantial modernization costs, and this complicates the establishment of primary metering infrastructure. Thus, the introduction of intelligent control systems is rather important for newly emerging cities.

Particular attention should be paid to the risks of intelligent cities' projects in Russia. The implementation process them is directly linked to the creation of public goods. Such projects may have insufficient investment attractiveness, since the proportion of the commercial component in the provision of public goods is low, so the system of intelligent management of city will have a low return.

Projects may also have low investment attractiveness due to their high costs and the need for substantial resources. So the process of creating intelligent control system is a complex technical process and should be provided with personnel, technology, information, financial and material resources.

Another important risk is the existing social differentiation of the population, so the services may not be available for certain groups (low-income groups, older people, people with disabilities, migrants, etc.).

Based on the foregoing, the need for intelligent development in a particular city should be clearly justified and takes account of the social structure of the urban population.

If we talk about the technical side of the implementation, the municipalities have systemic, technological, organizational and economic barriers for the implementation of intelligent managment systems [2]. Systemic barriers to implementing solutions for the "intelligent city" include:

- complexity of the tasks of the municipal government;
- lack of development of national standards in the creation, development, implementation and maintenance of automated systems and application software systems;
- lack of a unified system of quality assessment of automated systems and application software developed for municipalities and government agencies;

- lack of research and development work in the field of information management and municipal systems evaluation.

Technological issues include:

- shortage of domestic developments in the field of intelligent control (software platforms, software systems , automated control systems);
- integration of heterogeneous hardware complexity and software platforms;
- poor quality of incoming data;
- difficulty updating information.

Organizational and economic problems associated with:

- the high cost of implementation and support projects;
- low-skilled municipal employees for use, maintenance and technical support of modern software platforms and technical solutions;
- decisions excluding strategic objectives of municipalities and the widespread practice of manual control on the ground;
- accumulated structural problems in the sectors of municipal economy.

There is the negative impact of natural monopolies, which prevents liberalization relations (especially in housing and energy sectors of city management). The liberalization is an important condition for the creation of intelligent management system with multi-agent structure.

Thus, in Russia the spread of intelligent technologies in city management are expanded mainly in the cities, where intellectual and financial resources are accumulated and there is a strong administrative resources. Typically, these are the major cities, administrative centers and urban agglomerations.

Consider the experience of the implementation of intelligent control systems in some Russian cities. Today, some elements of intelligent management system implemented in the city transport, social, medical sectors, housing and utilities, security and control, and in others. If we generalize the existing experience, it highlighted several directions in the development of management systems in Russia: the creation of information portals and services, the implementation of geographic information systems (GIS), the introduction of smart grids.

The first direction of ‘intelligent city” includes the creation of portals and information systems to manage the various spheres of city’s life, providing interactivity with people and businesses, providing e-services to residents and authorities of the city.

The second direction of intelligent management is associated with the creation of geographic information systems. Similar systems have been implemented in Samara, Volgograd, Yekaterinburg , Armavir. For example, the existing geo-information portal monitoring center of Armavir is a resource that combines the basic spatial information and situational plans of the city, which allows:

- receive information about the location and speed of public transport in real time;
- monitor the situation in the city for the release of harmful substances into the atmosphere, to control pollution indicators;
- view and manage video from cameras installed on city streets;
- receive information on social sites: medicine, education, science, organization, culture, sports grounds;
- obtain information about the dilapidated housing stock; monitor engineering networks of the city; manage emergencies on networks;
- implement scenario emergency response;
- maintain newsfeed events.

The third direction concerns the energy efficiency of city’s energy sector. It is created highly energy infrastructure using technology “Smart Grid” in a number of Russian cities.

Summarizing the existing experience of creating intelligent management systems in the Russian cities, we can conclude that still has not developed a single, comprehensive approach to this process. In international companies, such as IBM, the solutions of intelligent management in cities for Russia doesn't take in view the specifics of the Russian cities, and so they practically no realizable. Already implemented solutions in Russia - it is only the individual elements of large intelligent management system.

Creating the intelligent city is a complex and multilevel process of change of the urban environment, which is based on the planning and organization of urban space with new information, communication, technological developments [3]. Process may be broken down into the following steps:

1) Create a primary measurement and communication infrastructure using new technologies, installation of software and hardware for processing, analysis and management of incoming information, implementation of automated control systems.

2) Construction of buildings in accordance with the new requirements of energy efficiency and "green standards".

3) Creation of innovative energy supply system of the city.

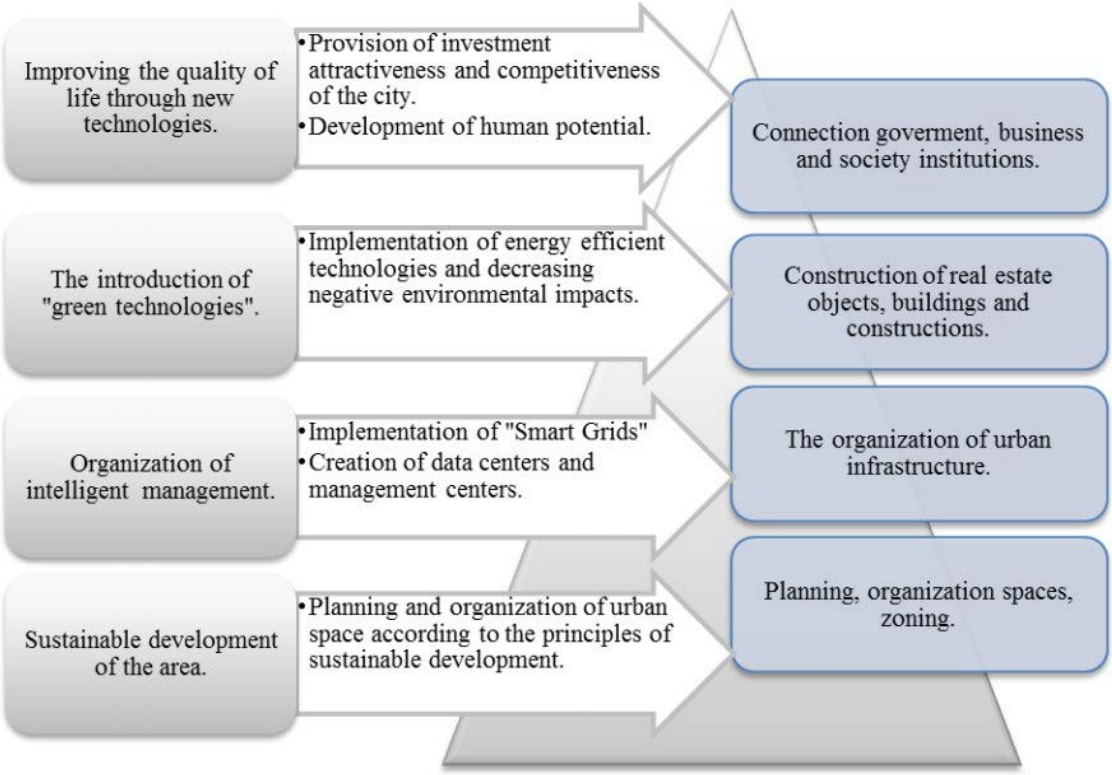
4) Intelligent management of the city infrastructure. Establish an information network with the control center.

5) Parenting smart population: the selection and training.

6) Dissemination of innovations in various fields of industry, city clusters livelihood. Creating jobs highbrow. Introduction of new services, services and social programs.

7) Implementation of intelligent life model that seeks to improve the quality of life.

Scheme 1. Model phased creation of "intelligent city"



When you create the intelligent city system should be guided by the basic principles of innovative urban policy [2]:

1) creation of conditions for localization of function-oriented infrastructure to support attributes territories (“growth points”);

2) the cluster approach in the planning and organization of the functional structure of the support areas;

3) adaptive management processes of urban planning based on innovative methods of modeling systems for sustainable development;

4) integration of resource-saving technologies, the application of the principles of “green” construction , the introduction of biotechnological systems of resource provision , the creation of complex service by international standards ;

5) the establishment and implementation of the participation of the state sound system creating effective investment products suitable for global portfolio investors;

6) the creation and use of global information service-oriented electronic systems for communications and information forming multidimensional models of city-planning activities;

7) the transition to the standards of project management at all stages of development and operation of capital construction , planning and implementation of urban development projects and programs .

For effective management of urban subsystems, the process requires an integrated approach that provides interaction between the main subjects of city’s economic activity, taking into account the specifics of management in Russian cities [4].

On the basis of existing experience in creating management systems, the Russian theory and practice of municipal management, the author has developed the scheme of intelligent management of the city, including the management of sectors of the city.

The proposed scheme of intelligent city management should be provided by multilateral information flows between people, voluntary associations of citizens, public authorities, municipal enterprises, non-public economic entities, statistical agencies, unions and associations of municipalities, state and municipal agents of supervision and control, financial and credit institutions and investors.

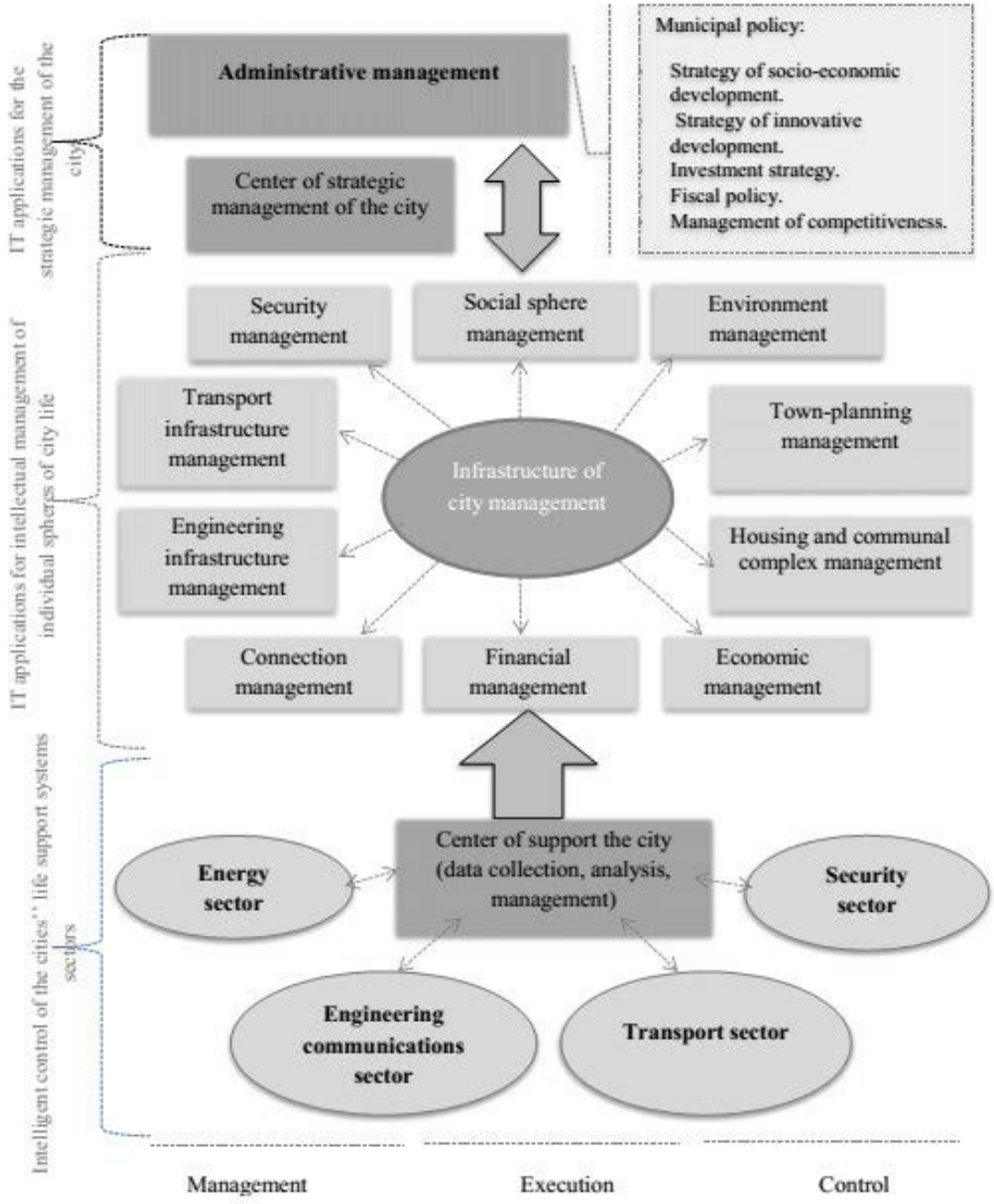
First of all it is determined the basic parameters, goals and objectives of the city administration for the intelligent management system. These include the legal basis, territorial, organizational and economic activity, especially the interaction with federal authorities, with the state authorities of the Russian Federation with a population with businesses, intermunicipal and international interactions. The system should be provided complexity, balance and cohesion of the individual subsystems, consistency issues urban development with the overall strategy of socio-economic development of the municipality.

Then, at the level of administrative management, it is introduced technologies of information solutions for the strategic management of the city, which provide monitoring of the implementation of goals and objectives, data collection, analysis and management. In this system, the city management carries out planning, organizational and legal control, analysis of the results. The system provides two-way communication with the population of the City Administration, business and non-profit organizations; allows comprehensive consideration of socio-economic processes, builds the basis for public-private partnerships and support competition.

Formed intelligent management infrastructure includes the following control blocks: safety, social services, environment, transport infrastructure, engineering infrastructure, city-planning, housing, finance, economy, foreign relations.

Block “Transport infrastructure management” includes automated management of road transport infrastructure, automated management of public transport, traffic inspection, regulation of transport and parking situation.

Scheme 2. Intelligent management of the city



Block "Safety management" involves the creation of a system providing monitoring of the situation on the streets , a rapid response to an emergency, as well as support for public order, fire safety , public safety and job Ministry of emergencies.

"Management of engineering infrastructure" is a system of monitoring the state of communications, the rapid identification and elimination of accidents and malfunctions, etc.

Block "Social sphere management" is the most difficult because it involves the system of social services and social protection, employment, demographics, education and science, health, sports, and youth policy, culture and cultural heritage, archives and the registrar. In this block, for each area developed a separate application of intelligent management, focused on the specifics of the sphere. Subsequently, each application is integrated into a single intelligent management system.

"Environmental management" involves the introduction of systems for monitoring and management of the environment.

The intelligent management block "Town planning management" ensures the implementation of the automated building permits, control urban development activities.

Block "Housing and utilities sector complexes management" is the most difficult to manage because of the high social importance and a number of structural problems. The intelligent management system for the housing and utilities sector is a multi-agent control system, which involves suppliers, consumers of utility services and service companies. It seeks to improve the quality of services industry and their availability, support the development of self in apartment buildings.

"Financial Management" includes an intelligent budget management, tax accounting and taxes, accounting and other enterprises, as well as electronic forms of reporting.

Block "Economic management" involves the introduction of a system of control and competitive pricing, trade and management support services for industrial production.

"Connection management" involves the creation of an information field, urban space information environment. The system provides media relations, public relations, investors, government and public organizations, the provision of electronic services, conducting surveys and elections, international and interregional cooperation.

The municipal services industry is the most strategically important and difficult to manage. It is presented in the scheme of the following sectors: energy, communications, transportation and security. The main requirement for an automated system of intellectual control these spheres - is continuity, reliability, security and stability operations. Management is organized on the basis of intelligent network (technology "Smart grid"), the implementation of which includes the introduction of intelligent instrumentation, sensors, automation systems, information networks, software development at various levels, the introduction of technological elements, control systems, database warehousing and unified management. It is also expected to develop an open energy market in the energy system.

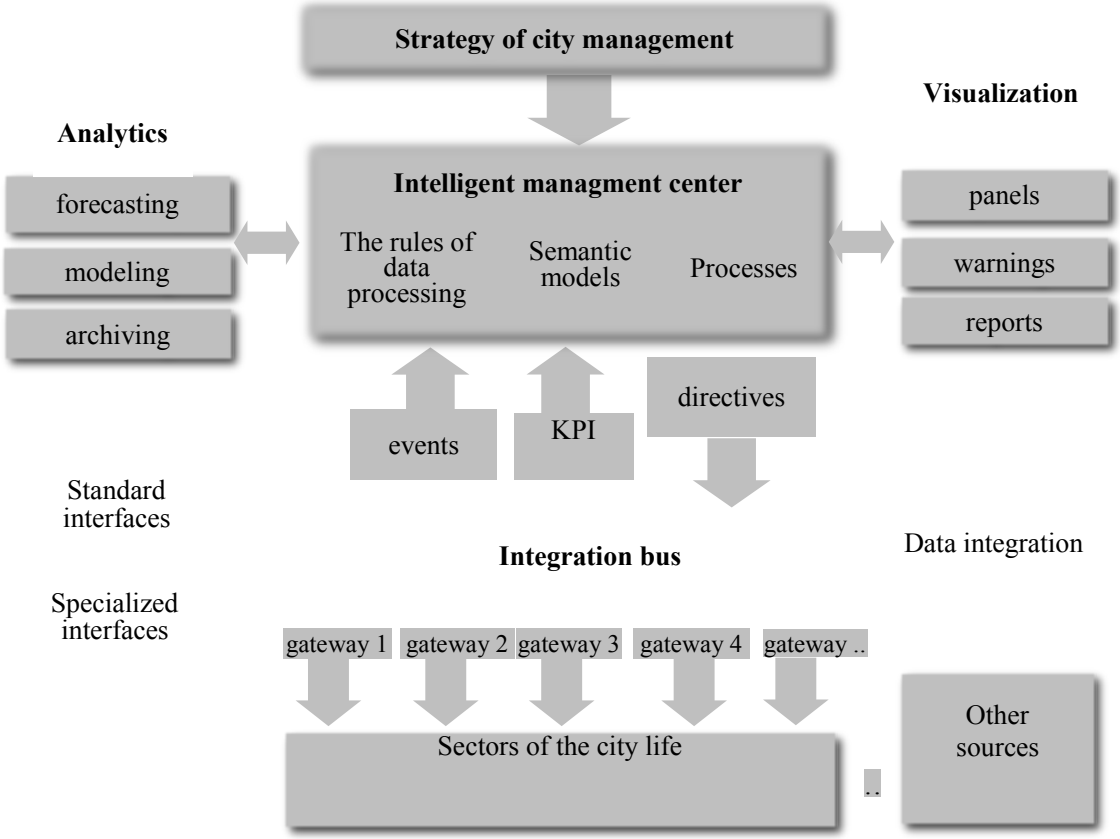
This scheme should implement intelligent management the following tasks: data collection, forecasting problems, timely response, coordination of resources and processes, effective management. However, it must meet the requirements of integrity, communication, sustainability, self-organization, feedback, self-regulation, adaptability to changing environmental conditions. At the same time, the system must comply with such properties as productivity, effectiveness, efficiency.

The management of same multi-complex subsystems realized through the center of strategic management of the city, which provides data collection, monitoring, control, management and emergency response. If we imagine the architecture of the project a single center of intelligent management of town, it can be presented in view of the scheme.

Operation principles of the intelligent management center are determined by the strategy of city management. For management center the rules for processing incoming information, semantic models and processes are described. Intelligent management applications for the cities' sectors are connected through gateways and an integrated bus with the control center. Databases are stored on the server. The received data are produced analytical operations: forecasting, modeling and data archiving. Visualization is performed with the help of a panel that trigger alerts, reports are formed. The work of this center requires constant technical support.

Summarizing, we can say that the system of intellectual management of the city, in essence, is a scale project of informatization the urban environment with the use of new information, telecommunication, technological innovations (particularly "Smart Grids"), aimed at improving the quality and efficiency of urban management, economy of resources. This ensures competitiveness and investment attractiveness of the city.

Scheme 3. The architecture of the intelligent center of city management



For organization of intelligent management system providing multilateral interaction between the population, the authorities, business and non-profit sector, need a strong administrative resource and support to local authorities. The process must be provided with the human, technological, informational, financial and material resources. Therefore, the optimal organizational and economic method of a full-scale system «intelligent city» is a state order, proceeding from the Strategy of city development with enhanced use of innovations in management. The Strategy should take into account the political-legal, scientific-technical, cultural, natural, economic and socio-demographic factors. Used organizational and economic methods should consider the fact that the city is a single organism, and hence management of each separate sector has a synergetic effect on the development of the whole city. And the politics of urban management requires liberalization.

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METHODS AND TOOLS OF INFORMATION PERSONALIZATION IN PROJECT AND PROCESS MANAGEMENT SYSTEMS

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In this paper we consider the current state of information personalization in project and process management systems. We consider a typical structure of the project and processes management system. Moreover, the research of modern methods and means for the implementation of personalization information, evaluation of the components are presented. The result of this research is a framework for building systems to personalize information and a description of its integration with existing systems and processes of project management.

Keywords: information personalization, project management systems

Introduction

Project and processes management systems are modern tools for managing information flows.[1] There are bug tracking systems and distance learning systems among such kind of systems. The development of these systems led to the emergence of various methods and tools to manage the processes within these information systems. Trends in the development of such systems has led to the complication of both the systems as a whole, and professional qualification that is needed to work with them.[2][3] The last decade due to the development of tools for automated processing of large amounts of data trends in the development of project management systems changed to customization of information, that they contains and social interaction.[4] Thus, for modern project and processes management systems prospective task became to improve the efficiency of information perception by a specific user, the verification of the information they perceived and reusing it to solve specific practical problems. Thus, the personalization of information poses a similar problem for project and process management systems, in particular for education ones. [5]

Principles of project and process management system building

As previously mentioned typical modern project management systems are complex multi-component tools. Different systems solve complex problems using different approaches and methodologies. However, the most systems have a similar structure and basic concepts and entities in these systems do aren't differing.

Thus, the main essence of project management, bug tracking or distance learning is a task assigned to one user (client or teacher) to another one (executor or student).[2] The task has a status and workflow. The purpose of the user in the role of the executor is to complete actions that transfer the task to another status, such as "fix" or "won't fix". This action sequence is called a resolution for the task. Return to the previous status, usually indicates a wrong resolution by previous executor. Tasks are grouped by project, similar to how specific topics in

distance learning are grouped by discipline. Within each project task status change rules and regulations usually are similar in various projects - different.

Project and processes management systems usually contain similar tasks that require the executer to follow the previously defined instructions. These instructions may be provided to the user as theoretical solutions and compiled during the process of solving a similar problem. In distance learning systems, the trainees face similar tasks within a single topic, usually these tasks are repeated: users with the same set of knowledge supposedly get similar tasks. Such events are also typical for the bug-tracking systems with the only difference that the executer can receive many same tasks over a long period and follow the instructions compiled and optimized by them.[7]

Instruction for solving the task is not often created for a current user. Including the situation the current user may not know about the existence of instructions for this type of tasks. In this case, the executor should have instructions on filing instructions to solving the type of problems.

Thus, project and processes management systems can be regarded as a set of similar events, consisting of sets of conditions: the task and its description, instructions for solving the problem, executor, presented his alleged knowledge as a set of instructions for solving tasks. Also the history of other users' behavior in solving tasks is available in the system.

Methods and tools of information personalization

The issues of information personalization are similar to the issues of information search, except that as a user query is considered in the project management system as the event described above, and the search area as theoretical knowledge about how to solve the task and collect information on the status of similar solutions. As a tool to determine the relevance of the results should also be used collect information about user behavior, assumptions about his knowledge.

1. The principal tools of information personalization are recommender systems and decision support agents. Stages of building a recommendation system are:
2. Normalization of the event collection to search for similar tasks and scripts execution, as well as strategies to address the current users.
3. Searching association rules whose purpose is to identify the strengths and the type of task dependencies other conditions specific type of event from the workflow.
4. Extracting user preferences in the current session to update the applicability of the rules identified at the moment for a particular user.
5. Making recommendations based on the data collected, including the selection of teaching materials recommendations and instructions given alleged knowledge of the user.

Normalization stage event collection includes drawing text vector model and clustering that is based on this model and metadata. Also normalization of user profiles is performed. User profile is a set of keywords (terms), taken from the vector model making them tasks or requests instructions. Vector length also depends on the following parameters: the first and last prescription references to materials containing a term referring to the frequency content. Also normalization of events includes indexing transaction: i.e. facts of user interaction with the materials. These transactions characterize user behavior model and represent the sequence of actions performed by the user during the task execution.

Searching association rules carried over transactions in the system, taking into account features such transactions, defining individual perception, such as a model of user behavior, the novelty of the term set for this user. These rules allow you to make assumptions about the user's strategy and make recommendations when it was sufficient for the analysis of a set of transactions. General recommendations for the compilation of the system to new users or those whose behavior is not yet defined in the case of specific events related to the task. For the purposes of the search algorithm of association rules approach Apriori.[6]

The foregoing steps are complex computational processes, so are conducted periodically as any OLAP.[8] However, for making recommendations require the use of OLTP, as you need to get the results of the system in a timely manner, while executer is addressing the task. In this case it is necessary to take into account all the events specific to a particular user session, including: the transaction committed in the session and the recent past. Any deviations in behavior, choosing a strategy for solving the task must be in the current session of greater weight than the previous revealed features. However, in subsequent sessions, weight deviations in a typical user behavior should be taken into account to a lesser extent.

Drafting of the final recommendations of materials is a characteristic of the process of formation of the SERP.[9] At this selected the most relevant topics and facilitate the speedy and correct solution of the problem in the past materials, conducted individual ranking results in order to provide first and foremost the most requested user information, which he presumably does not possess. The assumption of having information is based on patterns of behavior (frequency of treatment to the instructions in the event of recurrence of similar problems), the period that has elapsed since the last access to the relevant materials and novel tasks for a particular user.

Evaluation for information personalize

Since the system is to make recommendations similar to search engines, apply some quality assessment recommendations. In particular, metrics such as accuracy and completeness can be used to assess the quality of the constructed system to personalize information. One of the key feedback parameters are referring to the materials presented in the recommendations, as well as the duration of exposure. [10]

Metric evaluation of the quality of personalization information can also serve as key performance indicators (KPI), adopted in the project management system. If the system has collected data on the problem-solving process to implementation subsystem personalization information, you can use the KPI similar events with and without the use of the subsystem.

Conclusion

Considered a set of methods and tools provide a basis for the development of the framework to personalize information, especially using project management systems and processes. The techniques discussed in the study take into account the individual characteristics of a particular user, it's history and current features selection solving strategies. Tools for building information systems personalization, allow us to make a specific prototype of a running system. Selected metrics allow the quality of the constructed system.

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TOOLKIT OF RISK - MANAGEMENT OF FACTORING

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In article the approach to management of risks of factoring on the basis of concept of risk as a three-componental component of threats, vulnerabilities and costs of possible losses is considered. The algorithm for construction of structure of threats of the company on the basis of the mathematical device of the theory graphs, the logical-and-probabilistic method is offered.

Keywords: factoring, modelling of risks, structure of threats, vulnerabilities.

The existing competition in the commodity markets defines an indispensability of flexible interoperability between the supplier of the goods and the buyer in conditions of limitation of turnaround means. Factoring allows to solve a problem of shortage of turnaround means and includes a complex of financial services: financing of the supplier, studying of credit status and monitoring of debts of buyers, conducting the account дебиторской debts, collection, acceptance of risk of liquidity. Use factoring allows suppliers to solve effectively problems of short-term liquidity and to adjust monetary streams, to expand the commodity nomenclature, to increase a delay of payments for buyers.

Domestic scientists-economists give significant attention to definition of essence factoring, classifications of its types, to forms of the organization factoring business in Russia and to its legal regulation. During too time, the questions connected with risks factoring of the companies and managements remain them insufficiently studied. Development of the theoretical and practical positions opening a content factoring and its risks, elements of system risk-management and its seats in a control system factoring business in modern Russian conditions, is one of key problems which decision will allow to raise quality factoring services and will create favorable conditions for their stable progress.

The risk factoring can be divided the companies into the risk inherent in conducting of any financial activity (market, percentage, etc.), and the specific risk connected with subject matter factoring, accepted from suppliers with the monetary requirements conceded by them. The least studied in the scientific literature there are the problems connected with minimization specific factoring risk.

Considering conceded accounts receivable as an active, factoring company spends an assessment of risks up to the conclusion factoring deals, that is at a stage of decision-making on conditions of financing of the client, by check of the available information on paying ability

of the client and its debtors. After the conclusion of deal the risks connected with performance of treaty provisions factoring are traced, namely: risk of delay/non-payment factoring payments, risk of falsification and swindle of the client/debtor.

However it is necessary to consider extent factoring deals in time – from an instant of the conclusion of the contract and payment of financing up to an instant of delivery of payments from the debtor (under the contract of sale and purchase).

The fullest approach to identification of risks is based on concept of risk as making of three components: threat, vulnerability, cost of loss. Threat and vulnerability are defined as follows: threat – set of conditions and factors which can become the reason for realization of negative event for factoring deals. Vulnerability – lacks of a control system of risks the companies assisting realization of threat. Factoring deal can be divided arbitrarily into some interconnected stages, on each of which probably to make the list of threats with a sufficient degree of detailed elaboration.

Probability of realization of negative event which in the given approach maybe in objective or subjective size, depends on levels (probabilities) of threats and vulnerabilities:

$$P_{neg.event} = P_{treats} * P_{vu\ln erabilities}$$

Accordingly the risk is defined as follows:

$$Risk = P_{treats} * P_{vu\ln erabilities} * Q$$

where Q - cost of possible losses.

For an assessment of threats and vulnerabilities various methods in which basis can lay are used:

- Expert assessments.
- Statistical data.
- The account of the factors influencing levels of threats and vulnerabilities.

One of possible approaches to development of similar procedures – accumulation of statistical data about really happened incidents, the analysis and classification of their reasons, revealing of factors on which they depend.

Necessary condition of successful realization of a control system of risks is completeness of the list of potential threats. For algorithmization of process of consolidation and decomposition of potential threats it is offered to use lexicographic concept of structure of threats on the basis of the mathematical device of the theory of graphs, the logical - probabilistic theory. Structure of type "threat" it is possible to present as the unit and-or association of base types "threat" representing actual objects and the phenomena bearing threats, and the association can serve object of generalization (classification). Classification of types "threat" is maybe expressed by hierarchy of attitudes between levels of the threats representing sequence of generalizations which elements can represent hierarchies of aggregations and-or associations.

The generalized algorithm of construction of such tree of threats looks as follows:

- In a root of tree T the threat correlated with set of threats of a smaller level of hierarchy (abstraction) is located.
- Final threats form leaves of a tree of threats.
- Association of a quantity of trees leads to formation of the complex structure $T = \bigcup_{i=1}^{M} T_i, i \in N$, which are possessing property of the partial order.

At construction of such trees three structural abstraction, being are used by specific realizations of the general concept of association: generalization, aggregation, simple association.

Aggregation and generalization allow to analyze and model the consolidated threat by a composition from elementary final threats for which quantitative assessments expert by means of the task of various scales can be received.

Radically a tree-threat threat of higher level settles down T_0 - which is connected with set of threats- leaves making it T_i. Thus, the consolidated threat is realized in case the sequence of threats T_i is realized lower order. For example, threat of swindle is realized, if counterfeit waybills and invoices (a fake of signatures, press) by the client for reception of financing under nonexistent deliveries of the goods are used and exists affiliation between the enterprises of the client and the debtor.

Association of a quantity of trees *M* leads to formation of the structure which are possessing property of the partial order. Such approach provides technics of structural modelling of threats.

Aggregation and generalization allow to analyze and model threats with enough complex structural organization, owing to a composition from elementary final threats. Applying the approach of ascending modelling, it is possible to present abstraction as result of process of synthesis of the consolidated threats from more simple threats. The analytical descending approach assumes decomposition of the basic consolidated threats with objective of definition by consecutive consideration and the analysis of each level of the detailed concept of a level of elementary final threats.

The descending approach is appropriate at the analysis of the threats, described complex structure and attitudes between elements of the given structure. The ascending approach is necessary for the solution to the problem of synthesis of structure of threats and consolidation of threats. It has to be noted, that application of one of the given approaches is not mutually exclusive.

The received structure of threats is the effective tool of the solution to the problem of identification of risks factoring companies. Use of abstraction as patterns, allows to reduce complexity of process of the analysis of factoring risks, by decomposition by logically associated elements to which can be compared quantitative and quality standards.

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AUTOMATED INFORMATION SYSTEM “ELECTRONIC INSPECTOR” FOR THE RUSSIAN MINISTRY OF EMERGENCY SITUATIONS

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This paper describes the architecture of the "Electronic Inspector" software system for information and analytical support, regulation and management of the safety supervision activities of the Russian Ministry of Emergency Situations (MES, international body is also known as EMERCOM). The introduction of the E-Inspector allows automation of the MES officials' work, creation of economy objects safety monitoring system and efficient supervision planning and management mechanisms.

Keywords: information system, distributed database, risk analysis, Markov models.

Ensuring the safety of people, territories, and economic property is directly dependent on the effectiveness of the MES's precautionary measures and supervision activities, according to their authority. The MES management system is hierarchical and includes territorially distributed branches, so it contains federal, regional, subjects', and territorial levels. Among the functions of the MES's State Supervision Agency (SSA), there are organization and execution of state supervision in the fields of fire safety, civil defense, and protecting people and territories in anthropogenic emergencies. The activities of the Agency are legalized by the respective MES's administrative regulations ([1, 2, 3]), which in turn reference to dozens of number of federal laws, codices, governmental acts and MES orders.

The pre-automation SSA data collection, processing and analysis had significant disadvantages, among which were labour-intensiveness, latency and high sensitivity to the quality of preliminary data generalized by experts and analysts on the bottom (territorial) levels of the MES hierarchy. Thus the creation of an integrated information system able to effectively collect, store and process all the existing data related to safety of supervised objects deemed necessary for estimating the current safety situation, make informed forecasts, developed efficient inspection plans and promote rational decision-making by the MES top officials.

The developed system was named "Electronic Inspector" and its major goal was formulated as increasing the efficiency of management due to common information and technological structure, effective interaction between all the involved subsystems, citizens and organizations. The system was to become the integrated information resource for automated processes related to supervising, monitoring the supervised objects safety conditions, and providing reliable safety information to all the concerned system users and stakeholders.

The major functions of the system may be divided into two parts: the supervision at local, i.e. regional, subjects' and territorial levels, and controlling and managing the supervision activities of various branches throughout the MES's SSA hierarchy. Thus the "Electronic Inspector" system consists of the two interlinked sub-systems:

- On the regional, subjects' and territorial levels of the MES's SSA this is the territorially distributed information system to automate the supervision activities and the objects safety conditions information collection – a specially developed software with distributed database.
- Throughout all the levels of the hierarchy, this is the system implementing the visualization, control and analysis of the objects safety conditions and their inspections results – a web application with integrated database receiving data from lower levels.

The distributed database allows automation of the supervision activities, the collection and processing of the objects safety conditions due to undertaken inspections throughout the Russian Federation territory. The scheme of the logical model of the system's information blocks interaction is provided on Fig. 1. For clarity, the information blocks that contain referenced and specialized MES data are joined into a group "Directories and glossaries of the MES". The normative-referenced information is set up according to the classifiers of the MES's universal classification system. Some of the referenced information is obtained via interdepartmental interaction, such as from Russian Tax Administration's organizations and

entrepreneurs registries, from Federal Addresses Information System's All-Russian database of population centers and addresses, etc.

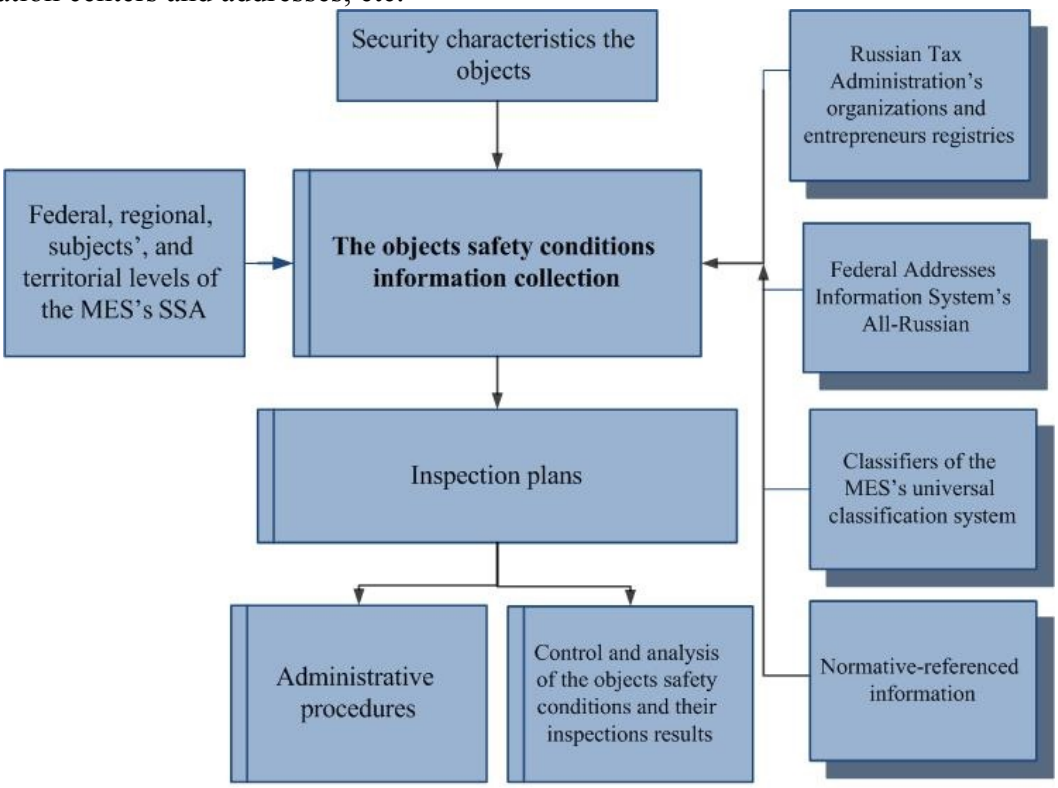

Fig. 1. The logical model of the system's database

The most important information blocks that set the structure of the entire model are shown with an additional frame. The other information blocks are represented as registries logically linked with the respective objects, their security characteristics and administrative procedures, formed as the result of the SSA officials' supervision activities.

The scheme of the multi-level structure of the implemented database at the top level of Russian MES is presented on Fig. 2. The database is developed with Firebird 2.1. and has a clustered structure – every SSA branch installs its own database, where the supervised objects safety conditions and inspection results are stored. It is submitted by the SSA's state inspectors, who supervise the authorized territory, and updated according to the inspection plans. With the frequency established by the system's regulations, the data from all the levels of the hierarchy are being sent to the top federal level and are automatically joined into the integrated database, the structure of which is identical to the bottom ones'.

The web application, whose name is "The System of State Supervision of the Russian MES" is deployed on the server at the federal-level intranet of the MES and is implemented as a set of modules (scripts) coded in PHP language. The software represents an integrated complex and works with Apache web server, FireBird 2.1., and MySQL database management systems. Every user of the "Electronic Inspector" system in the MES intranet, accesses it via a web browser and with provided authorization credentials.

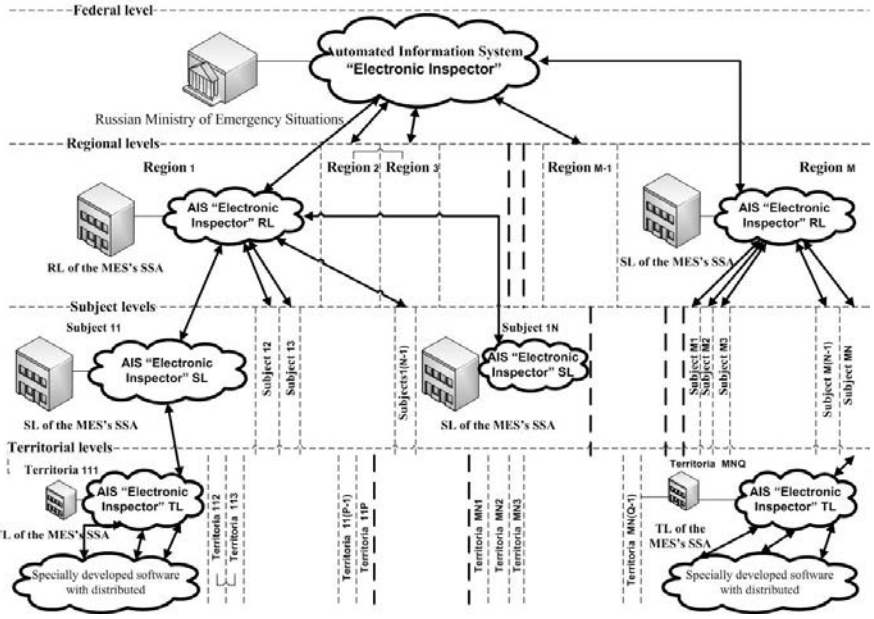

Fig. 2. The scheme of the territorially distributed management system

The web application of the automated information system "Electronic Inspector" (Fig. 3) allows browsing of the data on the objects safety conditions and the inspection results, as well as analyzing and planning the SSA activities and creating universal reports at all levels of the MES hierarchy.

So, the "Electronic Inspector" has web interfaces providing the following functionality:

- The visualization of supervision data in fire safety, civil defense, and anthropogenic emergencies protection for objects in the Russian Federation;
- The visualization of the data on inspection plans and results, on fires and emergencies in Russian territory;
- The automated and inquiry-based creation of statistical and analytical reports with various detail levels, on the supervised objects safety: by objects categories, by the SSA branches, by the Russian Federation territorial subjects;
- The automated and inquiry-based creation of statistical reports on the SSA activities performance indicators, on the supervision in its authorized fields;
- The creation of statistical and analytical reports on fires and emergencies in Russia: the changes in the number of fires and the involved losses, by objects categories, by specified periods (also in comparison with another periods), by specified SSA branches or by the Russian Federation territorial subjects.

The use of the universal approaches to the MES's SSA management and its officials' work is important as a factor intensifying the consistent decision-making, controlling the implementation of the previous decisions, as well as allowing analysis and planning of the SSA activities, ensuring universal reporting at all the MES hierarchy levels. The further development of the implemented system is planned in the following two major directions:

1. The creation of a subsystem for data analysis based on data mining methods, which would allow looking for regularities, such as associations and chains, and solving classification, clusterization, and forecasting problems.

2. The creation of a subsystem for risk analysis for most important or hazardous objects, which would be based on modern qualitative and quantitative methods for emergency events research, such as frequency analysis for fault trees, event trees, Markov models.

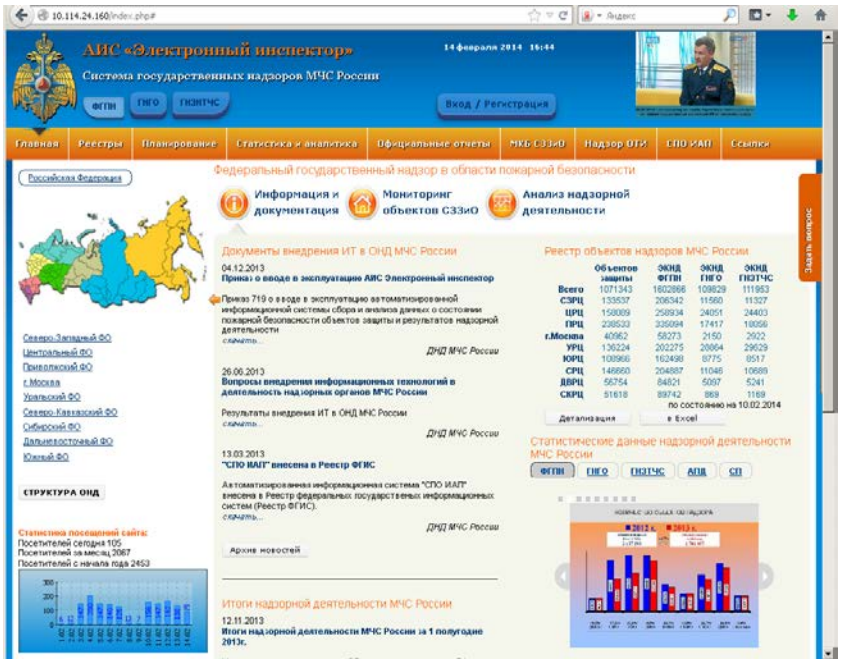

Fig. 3. The homepage of the automated information system "Electronic Inspector"

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DIGITAL ANTI-FORENSICS IN LINUX

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This article is focused on a description of some developed concepts of counteraction to local collection, preservation and data analysis on the computer. Special attention is paid to a providing the plausible deniability of presence of some sensitive information. The main point of this article is also the description of implementation and usage of these methods for working with the operating system Debian Linux.

Key words: forensics, linux, plausible deniability, boot

One of the current problems in information security is the counteraction to off-line attacks. That is why the purpose of our study was to attempt to develop the main concepts of protection the computer from local collection, preservation and data analysis. Having studied this issue, we tried to create common strategies that would be able to provide the safety of computer, allowing to avoid compromising data in case of its theft or loss, and help to destroy it as fast as possible without any contact with the computer. Below we introduce our solutions of these problems, describing our requirements to system and their practical implementation.

First let us consider the situation when it is not required to hide both sensitive information, and the measures applied to its protection. In this case it would be rather necessary to use the following configuration:

1. to use full-disk encryption;
2. to keep the system loader and key files for disks on the removable disk (that must be fragile enough for easy way to destroy in case of emergency), and upon that the keys and a part of configuration files of the loader must be encrypted by the password known to the user, that helps to protect information from disclosure even in case of theft or loss of the computer with the removable disk;
3. to set a BIOS password for counteraction to cold-boot attacks, as well as to put the computer in hibernation mode when it is out of the user's control, it will strongly complicate an implementation of attack.

For the implementation of this strategy we have developed the modification of initrd, that allows to load system by a bootloader from LUKS-encrypted volume using a key encrypted by ccrypt (utility for encrypting and decrypting files). Debian supports hibernation mode, therefore an effective attack needs simultaneous capture of computer, user and keys what is rather difficult to accomplish.

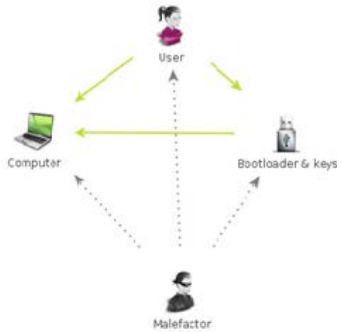
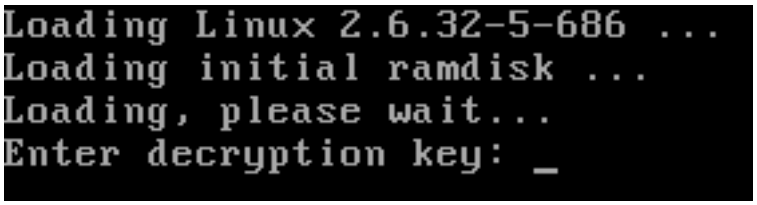
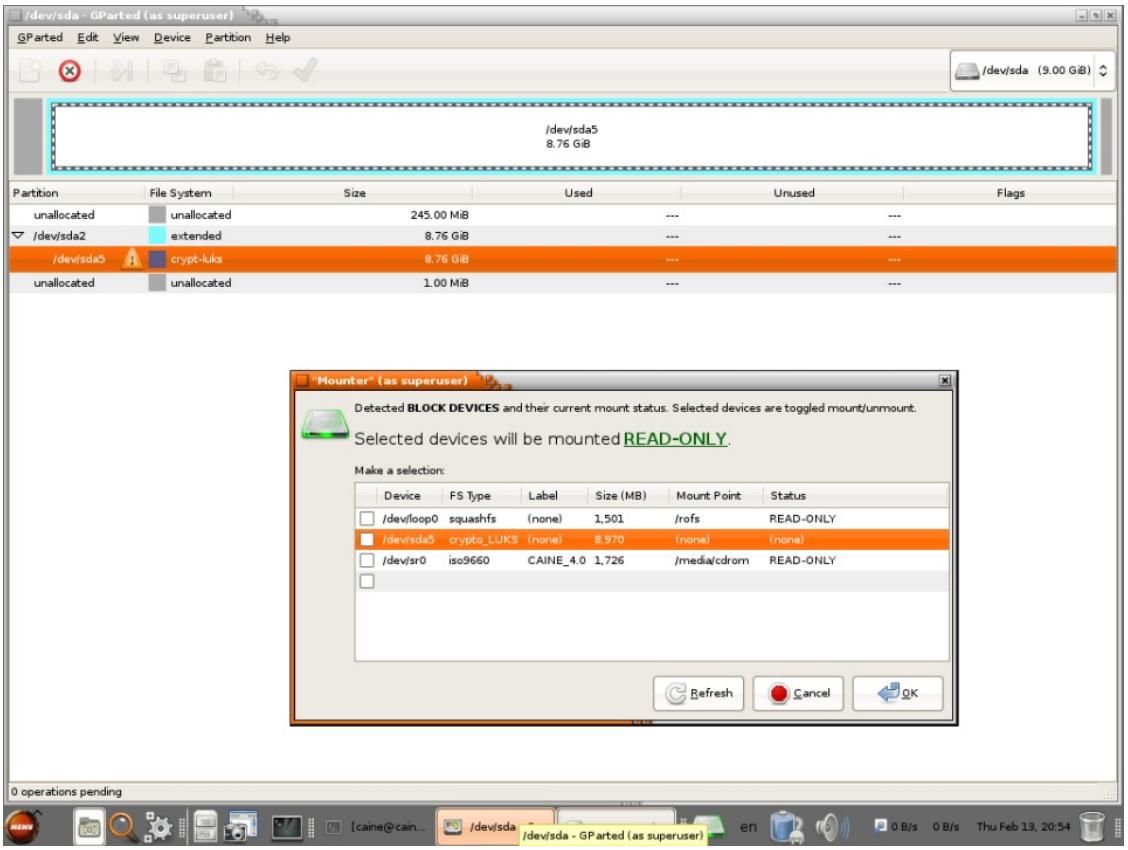


Fig.1 The model of above-described situation: A user needs a few seconds to destroy the boot loader, while a malefactor should capture the computer and the boot loader with key, as well as make the user to say the password.

Screenshot 1 illustrates the early boot decryption of the key file by ccrypt



Screenshot 2 shows that CAINE (Computer Aided Investigative Environment) detects our encrypted disk, but it is unable to disclose information on it without the key.



In other case, if it is necessary to hide presence of sensitive information, the following supplementary requirements must be met:

- used software should hide the fact of presence of an operating system;
- in this context the fact of usage of the software encryption should be not provable or the container should let in a possibility of equivocal decryption.

At the stage of the implementation Truecrypt (Free open-source disk encryption software) was embedded in initrd. This way was chosen because of its ability to support plausible deniability and its disks can't be identified by any patterns as they represent blobs of random data, also supplementary kernel modules were added. This strategy was executed in two following variants:

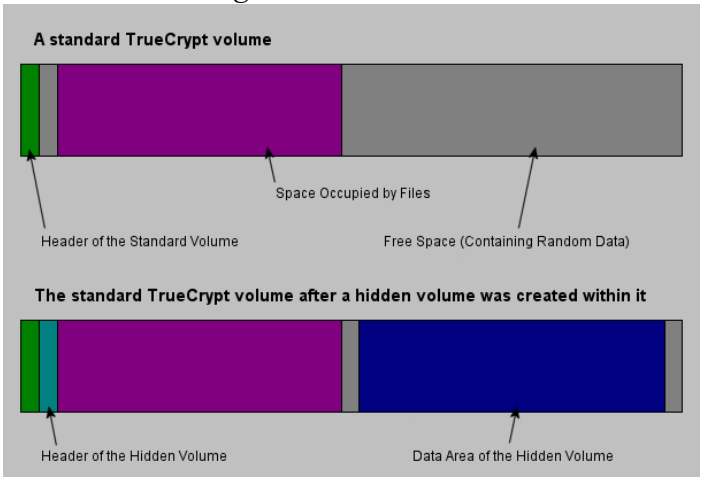
1. The hard disk is encrypted completely, it can't be distinguished from unformatted.
2. Root file system mounts from the container file being on partition formatted in NTFS/ext2/ext3 and containing hidden volume, for this we added kernel NTFS modules.

Hidden Volume

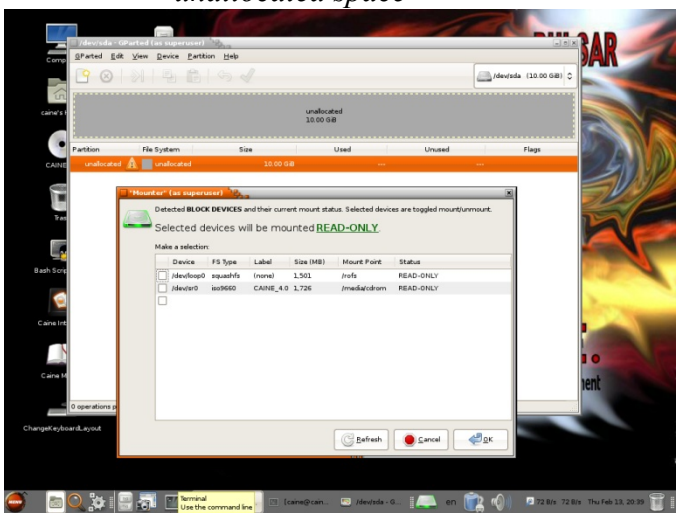
It may happen that you are forced by somebody to reveal the password to an encrypted volume. There are many situations where you cannot refuse to reveal the password (for example, due to extortion). Using a so-called hidden volume allows you to solve such situations without revealing the password to your volume.

The principle is that a TrueCrypt volume is created within another TrueCrypt volume (within the free space on the volume). Even when the outer volume is mounted, it should be impossible to prove whether there is a hidden volume within it or not [1], because free space on any TrueCrypt volume is always filled with random data when the volume is created and no part of the (dismounted) hidden volume can be distinguished from random data. Note that TrueCrypt does not modify the file system (information about free space, etc.) within the outer volume in any way.

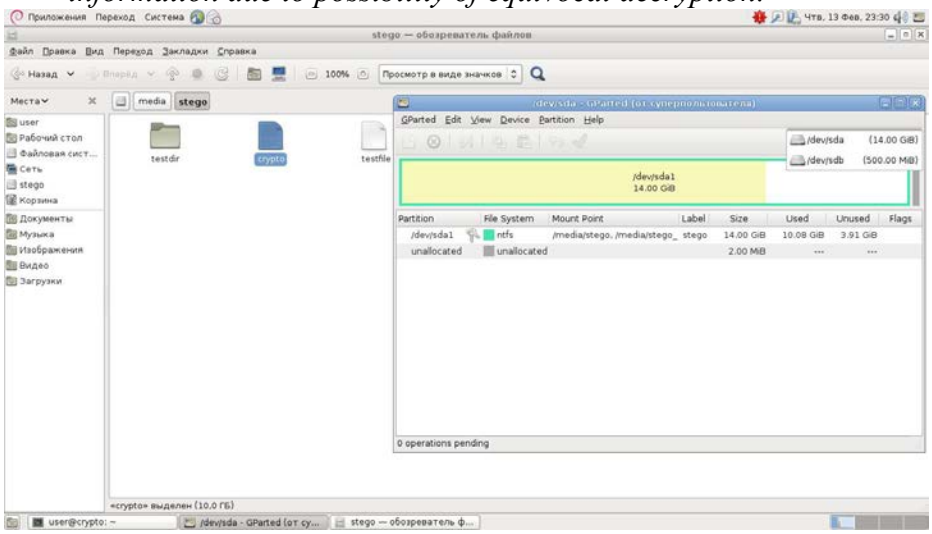
Fig. 2 Hidden Volume



Screenshot 3 illustrates that CAINE cannot distinguish encrypted disk from unallocated space



Screenshot 4 shows system, that rootfs was mounted from file "crypto" situated on NTFS partition mounted on /mnt/stego. In real situation it is possible that this partition contains another common OS and in it this container is used to store fake sensitive information due to possibility of equivocal decryption.



In this paper, we studied a practical implementation of the security methods of counteraction to local attacks. The point to be emphasized is that usage of these methods neither increases costs nor complicates the use of computer, it also doesn't seriously affect system performance on modern computers. Moreover, all implementations are open-source and permitted to copy and to modify. We are sure they effectively protect the computer from the most competent malefactors.

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NEW INFORMATION TECHNOLOGY IN DATA PROCESSING OF POPULATION CENSUS RESULTS

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The new technology used for data processing of population census results is described. The system was recently launched by Rosstat for 2002 and 2010 censuses. It gives the user an opportunity of on-line tabulation any demographic table from micro data with no need to download the data themselves and to set up any software. The examples of the results absent in the official census tabulation obtained by means of this system are given.

Keywords: population census, micro data, data processing, demographic tables, on-line access

Nowadays, the need for statistical information about the population increases in educational and scientific institutions, as well as among governmental bodies and business structures. Despite a significant increase in the amount of statistical data available in the public domain of Federal State Statistics Service (Rosstat), this information is often insufficient for analysis and projection of socio-demographic situation of the country and its regions.

As a way of solving this problem, statistical agencies of many countries organize public access to micro-databases. Since the most detailed information is collected during the population census, in most cases, access is given to these data. One of the largest international projects on population data at the individual level is IPUMS (Integrated Public Use Microdata Series, [1]).

In 2012, Rosstat granted to Internet users full and free access to micro-data of the 2002 All-Russian population census, containing information on private households. Software package SuperSTAR, developed by the Australian company Space-Time Research, was used for that purpose. The choice of this particular software is based on the fact that it is designed specifically for the purpose of granting access to large volume of anonymized micro-data at

high speed. This software is used by national statistical services of many countries for providing web-based access to the data of censuses and surveys, and is being improved by the developer on a regular basis according to the needs of users. Thus, SuperSTAR enables the user:

– to design an arbitrary table layout using any indicators covered by the 2002 and 2010 All-Russian population censuses;

– to form a table with aggregate data of the 2002 and 2010 censuses according to the terms characterizing the population on the base of the layout specified;

– to form queries with intersection of features of various objects (e.g., households and dwellings, or persons and households. While constructing a query, such as "households in which there are persons aged 15 years and older by the type of dwelling occupied", a conjunction of features relating to dwelling, person and household takes place, is an option not supported by most database management tools);

– to visualize the data in the form of tables and graphs;

– to export the tables generated in formats of MS Excel, xml or csv, and diagrams - in png or pdf formats.

In order to create an arbitrary table with the results of the 2002 and 2010 censuses, users need to know in details their program and methodology, which can be found on the official website of Rosstat [2]. In addition, different metadata describing the selected parameter are available to the user during the table design. Otherwise, the risk of receiving incorrect information may be high. For example, data on educational attainment for the whole population, instead of those aged 10 years or older, will have an irregular structure because the educational attainment of persons under 10 was not specified.

Generation of tables with the census results takes place promptly within a few minutes, due to the special format of data storage developed by Space-Time Research Company.

While providing online access to the census micro-data, Rosstat is obliged to maintain the confidentiality of personal data in accordance with the following federal laws:

– Federal Law of 27 July 2006 N 152-FZ “On Personal Data”: “confidentiality of personal data – the requirement, which must be observed by the operator or other party who has received access to personal data, not to allow their distribution without the consent of the subject of personal data or other lawful grounds”;

– Federal Law of 25 January 2002 N 8-FZ “On the National Census”: “Information on population stated in population census forms shall be considered confidential and shall not be divulged (disseminated). Said information shall be used for generating federal information resources”;

– Federal Law of 29 November 2007 N 282-FZ “On Official Statistical Accounting System and State Statistics in the Russian Federation”: “Primary statistical data contained in the forms of federal statistical observation is restricted information, except the information, access to which should not be limited in compliance with federal laws. Subjects of official statistical accounting should provide confidentiality of restricted information. Primary statistical data making restricted information should not be disclosed or disseminated and shall be used only to form official statistical information”.

Despite the fact that the primary information in the database is impersonal and inaccessible to users, it is possible to identify individual respondents due to unique features, typical for the surveyed group of individuals. Among such features are: date of birth or ethnicity untypical for the residents of this village, etc. First of all, the risk of disclosure of personal data is high for the residents of settlements with small population.

To protect personal data, Rosstat uses a distortion algorithm, which introduces minor distortion in the values of a table, making impossible the disclosure of confidential information. This ensures the representativeness of the data and users are not limited to access to the census

results by aggregation of the values of the indicators or territorial units. The tables that are slightly distorted in order to hide confidential data contain such a warning.

Table 1. Sample table formed without personal data protection algorithms (conventional data)

City	Total population	Age (years)								
		0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 and over	Not specified
Bronnitsy	191	6	12	67	38	48	10	6	4	-
Dzerzhinsky	81	4	10	18	22	10	13	-	1	3
Dolgoprudny	796	23	47	256	260	141	31	6	6	26
Dubna	71	3	10	9	6	17	9	5	7	5
Zheleznodorozhny	86	4	12	16	13	16	8	4	3	10
Zhukovsky	3712	35	105	985	1053	884	304	105	162	79
Ivanteyevka	242	5	6	91	91	29	6	2	-	12
Klimovsk	93	7	2	15	37	23	2	4	2	1
Kolomna	115	10	6	35	32	12	8	6	-	6
Krasnoarmeysk	19	-	1	8	6	4	-	-	-	-

Table 2. Sample table formed using personal data protection algorithms (conventional data)

City	Total population	Age (years)								
		0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 and over	Not specified
Bronnitsy	188	4	12	67	36	47	9	9	4	-
Dzerzhinsky	81	5	9	15	20	10	14	-	-	-
Dolgoprudny	797	21	47	260	257	139	33	5	7	30
Dubna	71	3	10	8	7	15	11	7	5	3
Zheleznodorozhny	84	9	13	15	15	13	6	5	4	10
Zhukovsky	3713	36	108	988	1052	886	300	104	160	81
Ivanteyevka	242	4	4	91	90	27	3	-	-	8
Klimovsk	92	9	6	13	38	22	3	3	-	-
Kolomna	112	11	9	32	37	13	9	7	-	7
Krasnoarmeysk	20	-	3	8	5	6	-	-	-	-

Any network user has access to the micro-database of the 2002 and 2010 censuses with opportunity to build arbitrary query that contain aggregate data, using web-site of Rosstat [3]. Registration is not required.

The system for providing access to the population census micro-data at Rosstat web-site is under regular development. One of the examples is a new feature for keeping the combination of characteristics of different persons in a family at tabulation. The direct opportunity of such feature was primarily absent for the 2002 census data. However it appeared for 2010 census after including in the list of characteristics of nuclear family the set of them for a husband and for a wife. After this it became possible to select, for example, the families with specified set

of ethnicities of husband and wife. The following table displays the result of combing several queries to the system, allowing to estimate the number of ethnically mixed families.

Table 3. Mono-ethnic and ethnically mixed marital pairs by ethnicity of husband, selected ethnicities outside corresponding national republics, Russia, 2010.

Ethnicity of husband	Number of families	Percentage of families outside national republic in all families in Russia	Ethnicity of husband and wife coincide	Ethnicity of husband and wife are different	Percentage of ethnically mixed families
Chechens	34139	15.69	28088	6051	17.7
Ingush	7937	13.20	6222	1715	21.6
Mari	38339	48.54	23679	14660	38.2
Tatars	474297	62.20	269669	204628	43.1
Kalmyks	2300	9.39	1228	1072	46.6
Bashkirs	59765	26.78	30827	28938	48.4
Chuvash	95543	45.81	47906	47637	49.9
Udmurts	20502	25.06	8938	11564	56.4
Mordovians	64482	58.79	20750	43732	67.8
Yakuts (Sakha)	773	1.23	209	564	73.0
Komis	3233	11.46	639	2594	80.2

Ethnicities are listed in ascending order of percentage of ethnically mixed pairs.

Let us consider as an example the queries resulted in two values in this table on Kalmyks. The following options were specified:

- Summing up: nuclear family (“family cell”), number of families (check-box), Add to row (button)
- Family cell: Type of family cell: Marital pair without children under 18 (check-box), Marital pair with children under 18 (check-box), Add to column (button)
- Responses of husband: Ethnicity of husband: Kakmyks (check-box), Add to row (button)
- Year of census: 2002 (check-box), Delete from a table (button)
- TEPCOH-ATE: Russian Federation (check-box), Add to row (button)
- Extract data (button)

The result contains two figures: the number of families of Kulmyk husband without children 7155 and with children 17342. The total is 24497.

The second query is the same except the territory:

- TEPCOH-ATE: South federal district: The republic of Kalmykia (check-box), Add to row (button)

The result contains the following figures: number of families of Kulmyk husband in the national republic without children 6491 and with children 15706. Their total is 22197.

Thus the difference between these totals gives us the rest number of families of Kalmyk husband outside the national republic. It is equal to 2300 or about 9.39 per cent of their total in Russia.

One of the most significant features of the system is flexibility at table design. The user has an opportunity to select the object for counting (person, dwelling, household, or family), a year of census (2002 or 2010), the level of territory (Russia, federal district, subject of the Russian Federation – oblast, kray, republic, up to the level of separate villages), as well as to specify the indicators of the object selected (age, sex, place of birth, educational attainment, ethnicity, etc.), the column or row as sides of a table under construction for each descriptor. For students, scholars, as well as the general public it opens quite new and very rich field of population studies. It should be noticed that the total number of objects described in the database exceeds 200 million.

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ANALYSIS OF THE METHODS FOR THE ASSESSMENT OF ENTERPRISE INTELLECTUAL CAPITAL

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The concept of intellectual capital and how to assess it are considered. 4 categories for measuring intellectual capital, grouped by K.E. Sveiby, are examined. It was concluded that every enterprises, owing to the specificity, selects individual methods for the assessment of intellectual capital.

Intellectual capital components are heterogeneous. Despite the fact that they are generated by the human intellect, some of them exist in the form of knowledge, inseparable from people possessing them, and others form objective conditions of application of this knowledge to increase enterprise competitiveness.

In scientific literature the concept of "intellectual capital" is used relatively recently. It was introduced in 1990 by Griliches relative to those intangible values, which define the difference between the market cost of the corporation and replacement value of its assets. It was only in 2000 when the intellectual capital was spoken about as a key resource of a modern enterprise. Leif Edvinsson and Michael S. Malone defined the intellectual capital value as a difference between the market cost of the company and the value of its net assets. At the present stage of research in the field of the intellectual capital theory the following scholars are engaged: E. Brooking, V. Geits, Galbraith, M. Castells, A. Toffler, V. Inozemtsev B. Leontyev, L. Miller etc.

L. Edvinsson was the first to define the intellectual capital as the knowledge and information which can be converted into cost. This opinion is shared by B. B. Leontyev, who defined the intellectual capital of the organization as the value of available intellectual resources. These scholars single out the following components of the intellectual capital: human capital and structural capital, which consists of organizational and client capitals. As soon as the intellectual capital was put on a par with other factors of production, there arose the problem of its measurement.

The most comprehensive review of the methods of IC measurement is presented by Karl-Erik Sveiby on his personal website (Sveiby K.E. (2004)). He identifies 25 methods for measuring intellectual capital, grouped into 4 categories.

Methods for the direct measurement of intellectual capital are called Direct Intellectual Capital methods (DIC). This category includes all the methods based on the identification and evaluation of individual assets in money or individual components of intellectual capital. Once individual components of intellectual capital or even individual assets are evaluated, integral evaluation of intellectual capital is derived. In this case it is not necessary to add the evaluations of individual components. More complex formulas can be applied.

Market Capitalization Methods (MCM). The difference between the market capitalization of the company and of its ownership assets is calculated. The obtained variable is considered as the cost of its intellectual capital, i.e. the cost of intangible assets.

Return on Assets methods (ROA). The relationship of the average income ratio of a company before tax deduction for a certain period to the company tangible assets (ROA) is compared to the similar indicator for a sector as a whole. To calculate the average excess return on intellectual capital the obtained difference is multiplied by the physical assets of the company. Further on, by direct capitalization or discounting of received cash flow, it is possible to obtain the cost of the company intellectual capital.

Scorecard Methods (SC). Various components of intangible assets or the intellectual capital are identified and generated; indicators and indices are generated and reported in the form of scoring of points or as graphs. Application of SC methods doesn't assume monetary assessment of the intellectual capital. These methods are similar to the methods of diagnostic information system.

All known methods of IC assessment fall easily into four categories listed. Besides, there should be noted relative proximity of DIC and SC methods, as well as MCM and ROA methods. In the first case the movement is on the identification of individual components of the IC, in the second one it is of the integral effect.

The first three methods are designed to carry out the cost assessment of IC. Unfortunately, such assessment is complicated. This is due to the absence of effective market structures, capable of determining the real market price of information and intellectual resources. Besides, it is not always useful for economic analysis. Dynamics of indicators of the same enterprise for a number of years or relative performance of similar businesses are more informative. Application of SC methods doesn't assume monetary assessment of IC. These methods are similar to methods of a diagnostic assessment of information system. Such (non-financial) assessment of IC is performed for the analysis of enterprise competitiveness as well as for the analysis of the factors of this competitiveness.

Techniques, such as ROA and MCM methods, offering monetary estimates, are useful at a merger, in situations of purchase and sale of business. They can be used for comparison of companies within one sector. They are also very good for illustration of financial cost of intangible assets. They are based on established accounting rules; they are easy to impart to professional accountants. Their disadvantage is in being useless for non-profit organizations, internal departments and public sector organizations. This is especially true for the MCM techniques, which can be applied only to public companies.

Advantage of diagnostic information system and SC methods is being applicable to any level of the organization. They operate closer to the event; therefore the obtained message can be more exact than purely financial measurements. They are very useful for non-profit organizations, internal departments and public sector organizations, for environmental and social goals. Their disadvantage is the context-dependency of indicators and the need for the indicators to be customized for each organization and each goal, which makes comparisons very difficult. Besides, these methods are new and hardly accepted by the public and managers,

who are used to treat everything from a purely financial point of view. In addition, integrated approaches generate large amounts of data, which are difficult to analyze and connect.

Most often in literature in one way or another connected with intellectual capital there are two methods: Direct Capitalization Method and Leontyev's method. Direct Capitalization Method (DCM) is a more widespread one.

Conclusion. All the foregoing methods are based on unilateral view of the intellectual capital. These methods consider it either as a product and calculate its prime cost (cost-based) or consider it as the capital and count profit from its use (profitable). Comparative methods have a more complex approach to the measurement of intellectual capital value. However, the owner of the enterprise is required to search and compare his business to a certain analog, but analysis of the market of intellectual capital is costly.

The most important disadvantage of these methods is that the intellectual product is almost always artificial and is appreciated just for its uniqueness; therefore the use of these methods is impossible under current conditions. An integral evaluation of the company intellectual capital is required. It should reflect multifaceted activity of an enterprise as a whole. Each enterprise should determine its own metrics of indicators for intellectual capital calculation.

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ESTIMATION OF THE EFFECTIVENESS OF CANCER DIAGNOSTICS AS A MEASURE OF PROTECTION OF POPULATION AT LOW RADIATION DOSES

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Approaches to evaluating the effectiveness of cancer diagnostics, caused by low doses of radiation (up to 100 mSv/year), based on a comparison of the value of saved lives as a result of detection of diseases at an earlier stage and the cost of diagnosis were considered. The results indicating that the diagnostics less efficient than interventions, implying a decrease in the level of radiation exposure of the population were presented.

Keywords: risk, radiation dose, costs, benefits, efficiency, diagnostics of diseases.

Ensuring of radiation safety in case of emergencies with radiation leakage in the territories of mass accommodation is traditionally based on a set of coordinated and economically reasonable measures aimed at reducing the risk of growth in the number of oncological diseases caused by ionizing radiation since 70th years of the last century [1-4]. This complex includes medicinal prophylaxis, measures limiting doses of internal and external radiation (reduction in the consumption of contaminated foodstuffs, water, deactivation and

conservation of the territory, temporary and permanent resettlement of residents and some others which are combined in the term "intervention") [5,6]. In this case, the justification of the intervention is determined by its economic expediency, which suggests that size of the effect exceeds the cost of its realization.

The effect of intervention is proposed to estimate like the cost of either residual or averted radiation doses or related with them relevant risk of losing years of life of the exposed population. Radiation doses and radiation risks usually have an aspect ratio in the models "dose-effect" based on assumptions of the linear no-threshold concept in case of low radiation doses (up to 100 mSv/year). Various modifications to these models take into account the dependence of risks not only on the radiation doses, but also on gender, age of the individual at the moment of radiation exposure and the manifestation of the disease, the type of disease [4,7]. International Commission on Radiological Protection (ICRP) has combined various modifications of these models in one aggregate expression in order to facilitate the practical application [2, 3]. This expression has following form:

$$R_d = K_m \cdot r_D^3 \cdot D = r_D \cdot D, \quad (1)$$

where R_d is a level of risk of death (the probability of dying) in period after radiation exposure; D is an effective dose of radiation (mSv/year), the residual after the intervention or prevent by it; r_D^3 is a coefficient of lifetime risk of cancer manifestation (for irradiated individual); $r_D = K_m \cdot r_D^3$ is a coefficient lifetime risk of death from malignant neoplasm of the irradiated individual; K_m is a fatality rate (mortality) of cancer patients.

In case of low radiation doses (up to 100 mSv/year) and the absence of sufficient and reliable statistics about its consequences, coefficient values are usually determined by approximating the regularities of the "dose-effect" from areas of medium radiation doses to areas of low doses, identified mainly with help of observational data about the victims of the atomic bombings in Hiroshima and Nagasaki in 1945, taking into account expert amendments [3,7]. In particular, according to the recommendations of ICRP, the value of this coefficient is proposed to establish at level $7 \cdot 10^{-2}$ /per.-Sv for the total population (0-85 years) and at the level $5 \cdot 10^{-2}$ /per.-Sv for the adult population (18-64 years). ICRP recommended using the following values for coefficient r_D: an average $5{,}5 \cdot 10^{-2}$ /per.- Sv for the total population and $4{,}1 \cdot 10^{-2}$ /per.- Sv for adult population [3].

Estimates of lifetime risk of cancer manifestation, which are averaged over the entire population (0-85 years) and adults (18-64 years) and specified by effective doses of radiation within 20÷100 mSv/year, for given values of r_D^3, are presented in Table 1.

Table 1

The estimates of lifetime risk of manifestation of cancer, which are averaged over age and specified by effective doses of radiation 20÷100 mSv/year

Radiation doses (mSv/year)	Average-risk level of population (0-85 years)	Average-risk level of population (18-64 years)
20	$1{,}4 \cdot 10^{-3}$	$1{,}0 \cdot 10^{-3}$
40	$2{,}8 \cdot 10^{-3}$	$2{,}0 \cdot 10^{-3}$
60	$4{,}2 \cdot 10^{-3}$	$3{,}0 \cdot 10^{-3}$
80	$5{,}6 \cdot 10^{-3}$	$4{,}0 \cdot 10^{-3}$
100	$7{,}0 \cdot 10^{-3}$	$5{,}0 \cdot 10^{-3}$

The described approach to the assessment of lifetime risks of morbidity and mortality of population caused by irradiation has been criticized by many experts in several areas [8] mainly due to the overestimation of levels which received by this method.

Acknowledging the validity of this criticism in their recent guidelines [3], ICRP recommended to reduce the risk assessment of 1,5÷10 times (usually 2 times) by using expert way in certain cases, in particular, at low irradiation intensity, its chronic nature.

In our opinion, even under some uncertainty of these estimates it is possible to conform or cast doubt the conclusions about the effectiveness and feasibility of using different interventions at different levels of dose of radiation exposure to the population based on them.

ICRP offers a two-tier system of criteria [2,3], in order to facilitate a decision-making process about the use of certain interventions in case of accidents with radiation leakage in practice. According to this system, boundaries (A_i and B_i) of doses are set for each measure, where i is index of measure. If the size of dose averted by i -th measure is less than A_i , $D \le A_i$, intervention is considered economically unreasonable. In case if $D \ge B_i$, intervention is recommended mandatory. In the range of $A_i \le D \le B_i$ decision to intervene must be made by territorial authorities, taking into account opportunities of optimization of associated with it results (ratio of benefits and costs). For the above mentioned "standard" interventions, after The Chernobyl Nuclear Power Plant accident, following dose limits were recommended: radiation monitoring, prophylaxis (for 1-5 mSv/year); limitation of residence for the groups of populations which exposed increased risk, such as children, pregnant women (for 5-20 mSv/year); deactivation of the area (for 20-50 mSv/year); compulsory relocation of population, limited use of the territory or its conservation(for 50 and above mSv/year) [2].

Taking into account criticism of the overestimated estimates of radiation risk at low exposure doses, subsequently ICRP considerably liberalized these recommendations by giving the responsibility of local authorities to decide whether to use interventions in the areas of doses from 20 to 100 mSv/year. When $D \le 20$ mSv/year almost all interventions except medical prophylaxis were found to be ineffective. When $D \ge 100$ mSv/year contaminated area is not recommended to use for agricultural purposes and conservation is recommended. It's decontamination is proposed to undertake only with a purpose to reduce emanating from this area radiation threat.

However, considered complex of measures of the interventions is not complete. At first glance, it is appropriate to include measures of health care for irradiated patients and diagnostics of cancer in this complex. This expediency are confirmed by data of Russian Cancer Research Center im. Blokhin, according to which the detection of cancer at an early stage significantly reduces the mortality rate among patients in case of provision of specialized health care. In particular, according to the averaged over all types of malignancies information, in the first stage of disease 97% of patients can be cured, in the second stage of disease 75% of patients can be cured, in the third stage of disease 30% of patients can be cured, the fourth stage of oncology is almost incurable [9].

We will try to approximately estimate the cost-effectiveness of this proposal, assuming that the costs of treatment of cancer patients in many countries of the world community almost the same and not significantly affect the difference in the coefficients of mortality.

According to the principle of reasonableness of any intervention, economic benefits from it must exceed the costs of its implementation [12]. The economic benefits of improving the quality of diagnosis of cancer among the exposed population can be estimated by the value of saved life which is calculated for one individual in a first approximation, excluding severity of the disease and the mode of survival of the population and can be determined on the basis of the following expression, taking into account the effects of discounting:

$$\Delta Q = \partial \cdot \Delta R \cdot \sum_{t=21}^{40} (1+d)^{-t}, \quad (2)$$

where ΔQ is a cost of reducing the risk of death from cancer (per individual); ∂ is the average cost of one year of an individual's life (assumed to be constant); $\sum_{t=21}^{40} (1+d)^{-t}$ evaluates the effect of increasing lifespan of an individual taking into account discounting in the case of his/her recovery from cancer; d is discount coefficient; the following formula

$$\Delta R = \Delta K_m \cdot r_D^3 \cdot D = \Delta K_m \cdot R_0 \quad (3)$$

characterizes the reduced risk of death due to earlier detection of cancer, where

$$R_0 = r_D^3 \cdot D \quad (4)$$

the risk of cancer incidence due to dose D; average duration of latent period of cancer after radiation exposure is 20 years; limits of 21-40 characterize the average period of life after the discovery of cancer for cured individual, given the fact that 5 is disease duration and 15 is average life expectancy in a healthy state [2,3]; ΔK_m is value of the decline in mortality rate by improving the quality of diagnosis of cancer.

The effect ΔQ is achieved by increasing the annual average per capita cost of diagnostics, which can be divided into two components. The first component determines the value of growth in costs at the stage from the moment of radiation exposure till the appearance of cancer. It can be approximately estimated based on the following expression:

$$\Delta Z_1 = (Z - Z_0) \cdot \sum_{t=1}^{20} (1+d_1)^{-t}, \quad (5)$$

where d_1 is discount factor of cost, in this case describing the decline in their value due to the reduction in the cost of technology, etc.; Z_0 and Z are cost levels for the diagnosis before and after irradiation. The second component takes into account an increase in average per capita costs due to reduce mortality among exposed population and continued diagnostics for survival people until the end of their lives, i.e. during 20 years after the discovery of the disease (15 years is an average period of life prolongation and 5 years is a period of the disease). Under the assumption that discounts characterizing effects of value reduction of life years and cost of diagnostic are equal in the future, i.e. $d = d_1$, its value can be approximately estimated based on the following expression:

$$\Delta Z_2 = [Z(1 - K_m(Z)) - Z_0(1 - K_m(Z_0))] \cdot \sum_{t=21}^{40} (1+d)^{-2t}, \quad (6)$$

where $1 - K_m(Z)$ is the survival rate of cancer patients in the case of costs for the diagnosis of diseases Z.

The exponent (*-2t*) at discount coefficient reflects the fact that this operation is carried out taking into account the decrease in value of life years of the individual and the decrease in cost of diagnosis.

For assessment of increments of effects and costs, we will represent a fatality rate of cancer patients as a function of the costs of diagnostics, under the assumption that the costs of their treatment are constant. An example of such a function is the following expression:

$$K_m(Z) = \frac{1-b}{\beta \cdot Z + 1} + b, \quad (7)$$

where Z is the per capita cost of diagnosis of cancer ($/year); b is a fraction of incurable cancer ($b \approx 0{,}05$); β is a parameter.

The expression (7) takes into account the main patterns of relationships in a pair of K_m and Z. If costs are zero (Z=0), K_m is equal to one (K_m=1). If costs tend to infinity $Z \to \infty$, K_m is equal to b ($K_m = b$).The effectiveness of increasing the costs of diagnostics decreases with increasing of Z.

The value of parameterβ may be estimated with a certain degree of reliability by using econometrics methods and statistics reflecting levels of mortality and costs of diagnostics of cancer in the world community countries. Parameter β can be approximately estimated based on the following Russian data: Z= 10$/year, $K_m \approx 0{,}6$.

Substituting these values in the expression (7), we obtain $\beta \approx 7 \cdot 10^{-2}$.

Note, β is equal $14 \cdot 10^{-2}$ for Z = 5$/year, and β is equal $7 \cdot 10^{-3}$ for Z= 100$/year.

Considering the expression (7) magnitude of the decline in mortality rate in case of increase in the costs of diagnostics from Z_0 to Z can be estimated based on the following expression:

$$\Delta K_m = \frac{1-b}{\beta \cdot Z_0 + 1} + b - \frac{1-b}{\beta \cdot Z + 1} - b = \frac{(1-b) \cdot \beta \cdot (Z - Z_0)}{(\beta \cdot Z_0 + 1) \cdot (\beta \cdot Z + 1)}, \quad (8)$$

With regard to (3), (4) and (7), expression (2) determining the per capita economic impact from improving the quality of diagnostics of cancer of the exposed population, takes the following form:

$$\Delta Q(\Delta Z) = \partial \cdot R_0 \cdot \frac{(1-b) \cdot \beta \cdot (Z - Z_0)}{(\beta \cdot Z_0 + 1) \cdot (\beta \cdot Z + 1)} \sum_{t=21}^{40} (1+d)^{-t} \quad (9)$$

The value of ΔZ_2 determined by the expression (6), taking into account (7) can be approximately represented in the following form:

$$\Delta Z_2 \approx (1-b) \cdot \gamma \cdot (Z - Z_0) \cdot \frac{\sum_{t=21}^{40} (1+d)^{-t}}{2} = (1-b) \cdot \gamma \cdot (Z - Z_0) \frac{\sum_{t=1}^{20} (1+d)^{-t}}{4} \quad (10)$$

,

where γ is multiplier which approximates the ratio

$$\gamma(Z - Z_0) = [Z \cdot \frac{\beta \cdot Z}{\beta \cdot Z + 1} - Z_0 \cdot \frac{\beta \cdot Z_0}{\beta \cdot Z_0 + 1}], 0.7 \le \gamma \le 1 \quad (11)$$

when Z changes inside wide limits at least $1{,}1 \cdot Z_0 \le Z \le 10^3 \cdot Z_0$ and $Z_0 \ge 5$ $/year, taking into account that

$$1 > \frac{\beta \cdot Z}{\beta \cdot Z + 1} > \frac{\beta \cdot Z_0}{\beta \cdot Z_0 + 1}, \quad \sum_{t=1}^{20} (1+d)^{-t} \approx 2 \cdot \sum_{t=21}^{40} (1+d)^{-2t}, \sum_{t=1}^{20} (1+d)^{-t} \approx 2 \cdot \sum_{t=21}^{40} (1+d)^{-t}$$

for

discounts d, which are within the limits 0,2-0,4.

A condition of efficiency of costs increasing for the diagnostics of cancer among exposed population has the following form:

$$\Delta Q \ge \Delta P_1 + \Delta P_2, \quad (12)$$

This equation can be represented considering relations given above for these variables as follows:

$$\partial \cdot R_0 \cdot \frac{(1-b) \cdot \beta}{(\beta \cdot Z_0 + 1) \times (\beta \cdot Z + 1)} \ge 2 + \frac{(1-b) \cdot \gamma}{2}. \quad (13)$$

From the expression (13) It follows directly that the cost of one year of life for which the diagnostics of cancer of the exposed population becomes economically reasonable must satisfy the following relation:

$$\partial \geq \frac{(2+(1-b)\cdot\gamma/2)\cdot(\beta\cdot Z_0+1)\cdot(\beta\cdot Z+1)}{(1-b)\cdot R_0\cdot\beta}. \qquad (14)$$

Given that the numerator of expression (14) is in the range of from 8 to 15, at least when Z satisfies $1{,}1\cdot Z_0 \leq Z \leq 5\cdot Z_0$, it is easy to see, that for $R_0 \approx 5\cdot 10^{-3}$, that corresponds to a range of effective dose 80÷100 mSv/year, costs of diagnostics become effective when the cost of one year of human life exceeds 30÷50 thousands $. Note that the evaluations of this indicator by the value of per capita GNI do not exceed $ 15000 for the Russian Federation , and do not exceed $ 50000 for developed countries .

At lower levels of risk of cancer incidence due to radiation, for example, at doses that do not exceed 50 mSv/year, diagnosis becomes effective when the cost of one year of human life is equal $ 100000.

The obtained results, despite their some degree of uncertainty, due to the simplification of procedures for their calculation and possible errors in the input information, generally indicate that the diagnostics of cancer as a measure that reduces the risk of loss of the population at low doses of radiation up to 100 mSv/year significantly inferiors in efficacy to other interventions pursuing the goal of reducing the radiation doses. Note that, according to our estimates, the decontamination becomes effective intervention when doses greater than 20 mSv/year and the cost of one year of human life excess $ 10000.

In this context, diagnostics of cancer can not be considered as a real alternative to these measures, although the social efficiency of diagnostics must not be questioned.

In general, diagnosis of cancer becomes an effective measure to reduce risks of loss of population, when radiation doses exceed 200 mSv/year.

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APPLICATION OF COMPUTER TECHNOLOGY IN THE PRACTICE OF NEUROVASCULAR CENTRES

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Questions to consider using digital computer technologies and methods of intellectualization of information processing, particularly ontology engineering in educational practices of doctors of neurovascular center. We discuss the possibility of improving the diagnostic work and thus the quality of research and preparation of educational material using the archives of medical images

Keywords: the means of ontological support, neurovascular center, telemedicine consultations

Research methods. According to experts, usefulness of the result of functional diagnostic analysis consist of three components- informational content, reliability and modernity. Lack of adequate diagnostic medical examination, entails sharp increase the financial costs of treatment of patients. The development and improvement of functional diagnostics closely related with digital computer technology and methods of information processing, frequency of ontology engineering[1-2], what allows to improve the general controllability of diagnostic process, quality of research and training study material using a modular ontological approach [3-5], in applying archives of images. The advantages of using digital functional and diagnostic systems in the educational practice refer to following factors: digital image reflection, digital information processing, and digital image storage. Consider the first advantage related with digital information storage. Dissipation of the image by levels of monitor brightness becomes available to the user. All range optical brightness can be used for storage of the one image area, resulting to increase contrast of the area of interest. At doctor disposal, learning in neurovascular center, there are algorithms for analog image processing in order to optimize the capacity of reflection systems, with a view of optimal using of facilities of system of reflection. This property also makes it possible to reduce the radiation exposure to patients by reducing diagnostic information. Digital reflection, with its computer processing, allows to see the quantitative and qualitative information and move from an intuitive image-empirical method to objectively measured [6].

Discussion. The significant advantage of digital computer diagnostics, in front of screen-film process ,are simplicity and speed of getting image. Image becomes available for analysis of doctor at the end of the exposure. Doubtless , the advantage of using digital computer technology in educational practice of neurovascular centers - it is an opportunity of digital image processing, namely archives and methods processing ,using resources of ontology engineering.

Also, subsequently we offer development of intelligent support , specifically ontologies of regional telemedicine center of counseling of citizenry by general practitioners (GP). It takes development of knowledge about consumer preferences and priorities of doctors when choosing organizational forms of patient service. At the same time , an ontological analysis [1-5] can be an important tool in the study of medicine as a social institution and social aspects and regional management of curative and medicinal preventive activity , as well as, the organization of medical service , satisfaction with various social groups of citizenry of medical service, structural and functional non-observance in the system of health care services.

The greatest development, currently, received the projects of telemedicine centers creation along the route - peripheral regions. But the most effective may be intraregional intra-regional projects of different levels , such as the route of Regional Hospital - CRH. In the project

proposes the development of a centralized regional telemedicine center and network station of tele-counseling, for using by medical specialists and general practitioners by solving problem of medical diagnosis and prevention.

Conclusion. New ontological principles of processing offer great opportunities of standardization of getting image, bring them to the standard of quality at the moment of getting and during deferred repeated research. It is important to have possibility of transfer image to any distance, by means of computer communications. Moreover, in the neurovascular centers an ontological information technology can be using for deciding such problem, as process of organizational analysis, making reports of works, making archival reference(duplicate of analysis), and all of that sort of thing.

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QUESTIONS BUILD MEDICAL SYSTEMS BASED ON CONCEPTUAL SPECIFICATIONS.

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The article presents the integration of sections and distributed data processing. Also presents aspects of declarative modeling, based on a modular system of ontological technology (MOST - technology), defines a mechanism for the design, operation and development of information system integration ontological modules (DOM).

Keywords: medical information systems, ontologies, declarative modeling, knowledge base, integrated medium

With a help of modeling tools we solve the problem of forecasting development of integrated medical information systems.(IMIS) including the formation of development strategy under changes in external environment; the choice of intention (IMIS) with an

accounting restrictions on the consumed resources; identify possible scripts of achieve the goal under the chosen strategy; determine the optimal script, etc.

Overview of decisions of integration distributed data and knowledge in (IMIS) [1,2] can be represented as data warehousing and knowledge.

The storage of data. In many companies, one of the first software tools of integrated information systems (IIS) were the storage of data, which operate under a principle of central storage. The storage of data different from traditional database (DB), because they are designed to support decision-making, instead for an effective data collection and processing. As a rule, the storage have a perennial version conventional database, physically placed in the same database. The data in the storage is not updated on the basis of individual user requests Instead, the entire database is updated periodically as a whole.

The storage of knowledge. If the storage of data contains mostly quantitative data, the storage of knowledge is much more oriented on qualitative data. IIS generate knowledge from broad range of database (include Lotus Notes), storage of data, workflow situation, external databases, Web-pages (both external and internal), and the information received from the users. That way, the storage of knowledge similar to virtual storage,where knowledge must be spread over a large number of servers.

Today, the main volume of structured data sources are the relational database , although it can be file systems , and XML databases , extending the scope of its application , and the other types of information sources. Regardless of the method of data storage , the first problem of integrating heterogeneous data, with which encounter on occasion the formation of storage (repository) information resources , is a variety of models and data schemas , their low level of abstraction , a small adequacy of reflection of semantic domain .For example, a good solution would be to move to a certain object-oriented data model , based on ontologies , which are in many ways similar to the semantic model , which is the key unit of complex structured data object (concept) that supports multiple attributes involved in various associations with other objects [2] .

For description of object-oriented data models using a variety of languages for description of object database schems: like

- ODL-ODMG standard object-oriented databases;
- RDFS (Resource Definition Framework Schema) - W3C standard allows to describe class diagrams and their properties with regard of their inheritance, restrictions;
- OWL (Web Ontology Language) - specialization RDFS, focused on the description of ontology.

The transition from the relational data model to ontologically - based model is a necessary step in building an open data warehouse [2-6] . Ontologically -based model allows to:

• to raise the level of abstraction of the domain model ;

•to distinguish canonical data schema that represents the intersection of export data schemas corresponding to different subject areas , to build a unified object requests for access to distributed data , followed by the aggregation of query results in accordance with canonical schemes ;

• to have a uniform reporting format provides a good syntactic and semantic interoperability .The matter of integration (technical interoperability) distributed data greater strength gains the Web- services technology as a means to provide uniform, platform-independent interface for remote access to information resources. In this context , Web- service acts as a stand-alone application that provides access to information, to external customers through a set of services provided to them . Technology of Web- services based on these open standards XML- like:

• SOAP (Simple Object Access Protocol) - XML- the protocol for remote method invocation Web- services ;

• UDDI (Universal Description, Discovery and Integration) - describes the data model designed for cataloging and detection services provided by Web- services ;

• WSDL (Web Services Description Language) - the language for describing Web-services interfaces .

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THE SOFTWARE OF ONTOLOGICAL PROTECTION IN THE GLOBAL INFORMATION SURROUNDINGS

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This article discusses the most dangerous sources of stress in the global information sphere. The author proposes the use of ontologies for information and psychological protection, in accordance with the different approaches to the study of stress.

Keywords: the hardware of informational- psychological protection, ontology, WEB-network

Stress - stress the body functional state under the action of various damaging factors (stressors) [1]. The classic definition of stress given G.Selje where stress is defined as no specific reaction to the description of requirements.

More universal approach to the study of stress in terms of functional systems , whose founder is the A.P. Anokhin, where stress is defined as chaos within functional systems when they are try to adapt to changing conditions.

A very interesting approach to the study of stress in terms of situations for conflict. They are considered as the main causes of stress. Prospectively study the impact of information

technology on the human operator and the development of effective methods of protection against new types of stressors.

Very interesting approach to the study of stress in terms of conflict situations considered in this case as its main reason [2]. Herewith information surrounding, with the development of global networks could be considered as part of the social , its specificity is about that it is substitute a human - operator some of the social and biological surroundings , there is a so-called virtualization .

The role of information and its semantic content in the modern world is steadily increasing , it is due , including , and with the increasingly rapid development of global information technology.

The common definition of semantics - the study of significations . (The word comes from the Ancient Greek concepts sēmantikós; important , and is based on the last word sema, i.e sign). Semantic technologies helps to allocate useful information from the data content of the documents or application code , based on open standards . If the computer understands the semantics of the document , it does not mean that he simply interprets a set of characters contained in the document. This means that the computer understands the meaning of the document.

The ontology and ontological analysis included in the procedures and standards for modeling , operational and production processes of various industries [3-8] .

.The main feature of this approach is that the separation of components of a real process, images and images classes and determination of their ontology or set of fundamental properties that determine their behavior changes.

Thus, the proposed method in the article provide ontological security methods using dynamic ontological analysis of sequences , significantly reduces the level of stress at work in the operator's global information systems .

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THROUGH SYSTEM PLANNING SPECIES QUALITATIVE PERFORMANCE MANAGEMENT UNIVERSITY

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The necessity to improve the structure and content of the programs of the national system of higher education, creation of necessary conditions for improving its quality by improving the planning system core activities of universities. A new model for seamless planning and support key processes in the system of qualitative university management. The new model will allow a seamless planning to achieve planned results of the university with a high level of responsibility and create preconditions for the establishment of the university evaluation system at the level of the region and country.

Keywords: education, planning, goal-setting, activity, process approach, the quality of the qualitative university management.

Russian Federation at the present stage of development claims to be one of the leading countries in XXI century, is at the forefront in the global economic innovation-oriented competition superpowers. An important factor in the formation of a strong economy, state and society is the quality of higher vocational education (HBE) . The national system of HBE in recent years implemented system changes to ensure its compliance with the requirements of both the innovation economy , the labor market needs and demands of consumers of educational services. By strategic objectives facing the national system HPE include improving its quality, accessibility and compliance with the new requirements of the modern development of innovation-oriented (IO) of the economy.

The total university management system quality management , including the management of personnel management, marketing, financial management and other components should guide the work of all departments of the university to achieve the main goal of its existence , taking into account the interests of all stakeholders. At the university should be set targets for all activities that achieve the main goal of its existence , its primary mission. Integration of different parts of the university management system into a single unit provides efficient management of processes and as a result , directly determines the state of the system , the level of the quality of national education space HBE. Qualitative university management (QUM) is a management system , linking into one interactive and interrelated processes of educational organizations (EO) , based on the process approach designed to achieve synergistic effects, achieve the goals of continuous improvement processes and results by the university to meet the ever-changing requirements and consumer expectations. Qualitative approach in education management and new requirements dictated by the law" On Education in Russia", " Russian State Program" Development of Education " for 2013-2020" [9, 16].

Modern university as a complex socio-economic system, equal to the largest organizations. Russian universities have not yet occupy a leading position in the international rankings, which many experts attribute in the first place, with underdeveloped domestic control system of educational institutions. According to Michael Barber, Professor of the Graduate School of Economics and the Graduate School of Education at Harvard University, one of the leaders of educational reform in the UK, " in order to improve the national education system in

Russia, need several conditions: compliance with international standards, the dependence of the quality system from working in her people, the efficiency of the leaders , their willingness to change" [7].

Heads of leading Russian universities are talking about the need for change in the system AFB towards achieving improvements for existing and emerging new requirements of consumers and stakeholders in the VPO system. "At State University has a margin of safety, but we need to change. Become more open and to actualize potential. Ratings - it is only a consequence. If you are efficient, then the rating you on the proper place. For example, MIT did not speak about the ratings, but the management of the university is always thinking how to change for the better " - interview Provost Tomsk State University - " We have to start the process of improving a real university. Unlike Superefficient research universities in three relatively simple things. First - this concentration of talent . Second - resources, and abundant. And the third-an efficient, modern and flexible management system" [8].

In the authors' opinion, it is effective planning activities QUM system should be one of the main components of the new models of governance, strategic goal, giving the modern university the opportunity to develop progressively. Planning of all types of universities should be implemented within the quality management system (QMS), and plan all its activities should be based on the process approach, one of the eight quality management principles [2].

Modern practice shows that planning intrahigh activities to ensure the quality is not paid enough attention to the accuracy of this analysis is confirmed by the information provided, the official materials on sites OE (plans of financial and economic activities, activity reports, etc.) [11-14], results of practice authors, the results obtained during the inspection audits certified QMS universities Penza region in compliance with GOST R ISO 9001. The main problems faced by the planning constraint effective and efficient management of the entire institution and affect the quality of education are the following:

1) in a number OE of planning Intrahigh not organized in the framework of the process approach, planning is carried out partially, not for each activity planned or not all types of work in the process. Planning process or in some university departments do not pay due attention. Feature of planning activities within the university process approach should be and what he has to obey the process model of continuous improvement of processes - cycle PDCA.

2) lack of formation and/or updating the strategy and objectives of the OE. Given that the modern university operating in a highly competitive environment, an important issue coordination planning with the development strategy of the OE. In some cases, the quality policy of some units do not reflect their specific activities.

3) there is no clear idea of establishing the goals of activities in some departments of the university and/or installation purposes fragmentary processes and/or the lack of them as such. No specific targets for processes is impossible to assess whether the effectiveness and efficiency achieved high or low. Objectives serve as guidelines when deciding what actions increase the effectiveness and efficiency of processes. A common characteristic of key performance indicators is that they reflect the results of many OE activities and give an idea of the direction of its development. Universities should exist to implement certain goals based on the needs assessment and constraints of the environment, and if it reaches them, the OE considered had been successful.

4) no planned activities to achieve the objectives of quality assurance activities HPE, not performance benchmarks established processes that arise from the planned objectives. No analysis of the causes and develop appropriate corrective action with respect to causes of failure processes planned objectives.

5) lack of planning documentation QUM, there is no evidence (records) analysis of action aimed at achieving planned objectives. Planning at the university should be documented

in the future: experts can refer to previous plans, to understand how a particular process is started, developed and led to success or failure.

6) lack of qualified personnel in the management planning process within the process and system approaches, as well as understanding and proper evaluation of staff (from senior management to the players) need to plan QUM. In many respects the data and a number of other related problems arise from the lack of the methodology IO planning QUM.

7) lack of openness and transparency in the planning and implementation for all types of structural units or the whole university for interested users.

Importance and urgency of dedicated planning of this study confirmed the statements of our President V.V. Putin, who in the course of its meetings in 2013 with the current ministers, heads of law enforcement agencies and other officials, has repeatedly pointed out the lack of competent planning activities of subordinate agencies. In his professional opinion [10]: the achievement of concrete results in the work depends on the planning, the quality of short and long term planning documents do not meet the set requirements, work plans many common phrases and fuzzy language; prescribed tasks in the planning documents are formulated vague, they should be as simplified, the plans are responsible for their execution are suitable not formally monitor the performance of their own regulations; plans should be publicly available documents should be made public. Similar shortcomings also encountered in planning domestic universities.

A model of seamless planning and key ancillary processes within QUM, taking into account the requirements and needs of all stakeholders of the university, which includes the consistent implementation of the following basic steps.

1 stage. Carrying out structural units of the university SWOT - analysis of the external and internal environment and the key support activities of the university, including information gathering, analysis of strengths and weaknesses, as well as its potential on the basis of available information [1]. Frequency analysis - at least 1 time per year.

2 stage. Formation based on the orders of management of the institution (and/or structural unit) Commission for the planning of key events and activities auxiliary intrahigh number of university employees authorized for quality, responsible for processes, students, employers, representatives of regional authorities and other stakeholders.

3 stage. Development (in case of absence) and/or updated by the university's development strategy for long-and short-term (3 to 5 years and for the current academic year, respectively), its mission, quality policy and other educational activities, taking into account the adopted strategy socio-economic development of the country and the region.

4 stage. Formation (in the absence) and/or updated by the OE processes and their interaction scheme. Interaction processes OE should be reflected in planning documents QUM (Figure 1).

5 stage. Definition and/or updated on the basis of the strategy, mission and quality policy objectives intrahigh processes with the necessary resources. When forming the goals should consider the results of the analysis to achieve the targets, successes and the reasons of failure targets prior planning period (usually a school year), developed corrective and preventive actions.

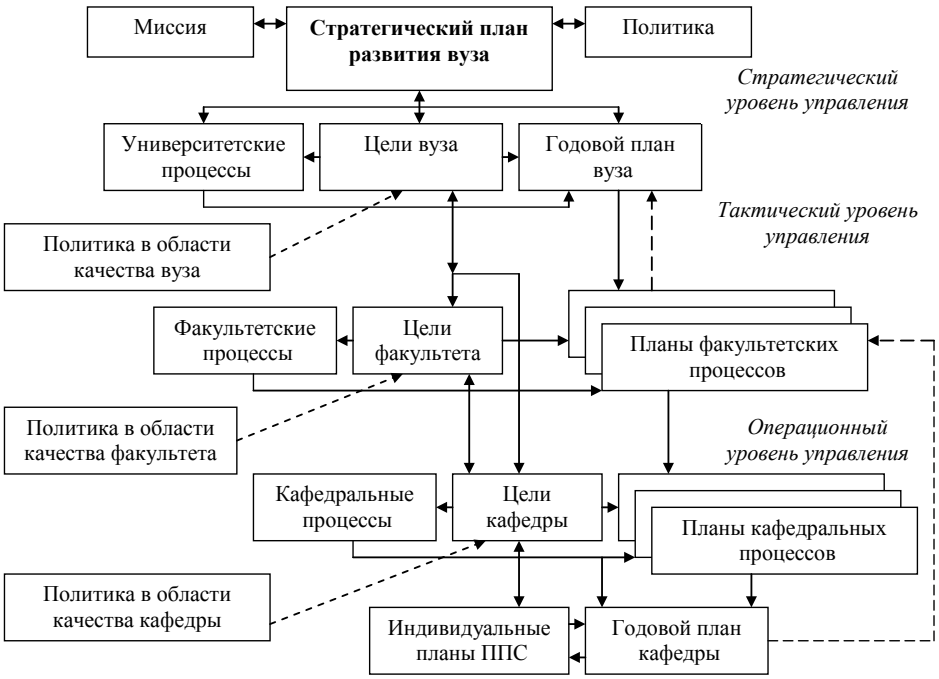

Figure 1 – Interconnection planning documentation QUM

In determining the goals of the university processes must be taken into account [4, 6]: a) specific and measurable objectives of the school for estimating the degree necessary to achieve them, and; b) achievable goals and reality in a given period of time, and; c) the orientation purposes the result of core activities; d) flexibility, adjusting them according to changing conditions of the external and internal environment of the university; e) compatibility in time and space; g) goals should not be controversial, as at senior management level and at the level of structural units; d) Acceptability goals (achievable, profitable, fair and safe for slave) - the degree of perception of employee goals as their own.

6 stage. Definition and/or updated measurable and achievable performance goals (PG) activities, as reflected in the documentation of the processes that we recommend setting a percentage or quantity.

7 stage. Event planning processes to achieve the main activities AFB (Table 1). [6]

Table 1 - Fragment, *as an example*, process goals "Implementation of basic educational programs" graduating chair "XXX"

Purpose of the process	Activities to achieve the objectives	Indicator/target value of the indicator unit
Provide the required level of quality of research students in the department	1 Ensure the availability and functioning of scientific circles at the Department	Number of scientific circles / 2 cup
	2 Ensure the participation of students in scientific circles	Number of students working in scientific mugs / at least 30 people.
	3 Provide presentations to students at various levels of scientific activities	Number of performances of students at scientific conferences, symposia, etc. / At least 7 ledge.

	4 Ensure the participation of students in research work	Number of students participating in the research work / at least 20 people.
	5 Organize students to participate in scientific student societies university faculty	Number of students of participating in the research university student societies, faculty / at least 10 people.

8 stage. Publication on the website of the university and its subdivisions plans intrahigh processes that will reflect planned objectives and activities to achieve them for each activity.

9 stage. Implementation of processes responsible for the activities to achieve the objectives and control by management.

10 stage. At the end of the analyzed period, the planning documents, the process responsible for a mark on the implementation of planned activities.

11 stage. Payment processes and system performance gain (Scum) analyzed period, as well as a generalization of results of the assessment, which must conduct a responsible person, for example, the head of the structural unit responsible for the process together with the authorized quality.

Calculation of a performance goals processes [5]:

$$P_{цель_i} = (ПЦ_{i\text{факт}}/ПЦ_{i\text{план}})100\%; \qquad (1)$$

where $ПЦ_{i\text{факт}}$ $ПЦ_{i\text{план}}$ - actual and planned values of quantitative targets *i*-th process.

Calculation of performance analyzed the i-th process $P_{процессі}$:

$$P_{процессі} = \sum_{i=1}^{n} P_{цель_i} k_{цель_i} 100\%, \qquad (2)$$

where $k_{цельі}$ - factor weighting (importance) *i*-th process goals; *n* - number of process goals.

Weighting coefficients $k_{цельі}$ determined by the expert method, involving experts from the staff of the university, authorized by quality, responsible for processes and / or other interested parties. Amount $\sum_{i=1}^{n} k_{цель_i}=1$. If the process is set one goal, the goal weighting factor $k_{цель}=1$.

Gathering information on the performance evaluation processes of structural units authorized by or responsible for the quality processes, and provide results for the generalization of the Department of the quality system.

Evaluating the performance of QUM $P_{кум}$ in the department of quality management system according to the formula:

$$P_{кум} = \sum_{i=1}^{N} P_{процессі} m_{процессі} 100\ \%, \qquad (3)$$

where $m_{цельі}$ - weighting coefficient (importance) *i*-th process, *N* - number of processes.

Generalization of the results assessing the effectiveness of processes and systems QUM. Application of recommended performance ratings for each process and system QUM will determine the impact needed to adjust processes and management system of the institution (Table 2). Interval qualimetric scale selected on the basis of conventional five-point grading system [15].

Table 2 - Interval kvalimitricheskaya scale performance assessment process and system QUM

		Conclusions and actions of the evaluation

Level of effectiveness of the process and system	The level of output values	process	SQUM
I High	100 and above	rezultativen process, to achieve the goals of maintaining and further developing the activities necessary to develop preventive actions	system performance; to maintain the achieved level processes and further develop the system is necessary to develop preventive actions
II Good	80-100	process is quite sufficient; activities are carried out efficiently, to achieve the goals of maintaining and further developing the activities necessary to develop corrective and preventive actions	system is at a decent level, constantly improving the quality of most of the activities, in order to maintain the results achieved and the further improvement of the system is necessary to develop corrective and preventive actions
III Medium (satisfactor)	60-80	process works in part; management decisions necessary to improve the planning and management process and the development of corrective action	lowest positive evaluation; system functions, but the goal processes partly achieved; necessary management decisions to finalize the planning and management processes and develop corrective action
IV Low	40 - 60	efficiency of the process is unacceptable; senior management needs to take management decisions in the field of quality to improve the planning and management process and the development of corrective action	system does not reach the goals; development requires senior management of administrative decisions to improve the planning and management processes and systems, necessary to develop corrective action
V Unsatisfactory	40 and lower	nerezultativen process, senior management needs to take emergency management solutions to improve the planning and management process and the development of corrective and preventive actions	system ineffective, requires revision and development of new senior management emergency management decisions in terms of quality to improve the planning and management processes and systems, necessary to develop corrective and preventive actions

12 stage. Calculation of the efficiency of processes and Scum and synthesis of evaluation results.

In the authors' opinion , the qualitative management system - a system of economic management of any entity. Can not speak about a qualitative management without departing from the system of management of the organization and , accordingly , the cost of quality - we have all of the costs of any economic entity incurred in the reporting period . Offered without breaking the rules of tax and accounting legislation , to assess the effectiveness of processes intrahigh classify quality costs in accordance with the processes of the university relating to basic its activities. At the same common classification , which guided the conduct of accountants financial and economic activity in order to meet the standards of accounting, tax and other laws remain , it should only be formed accounting department of the university for each process separately. This requires an assessment of the resources $З_{процесс i}$ (formation of the accounting costs for each process), which include cost elements according to the requirements of accounting and taxation, with the necessary compliance with the following algorithm:

- Receipt of documents on the costs side and compilation of primary documents in the university;
- Design of primary documents about costs and their implementation;
- Delivery of primary documents about the costs to the accounting department;
- Processing of documents in the accounting of the costs;
- Ensuring the current storage (during the year) documents about the costs;
- Allocation of costs to processes $З_{процесс i}$ for the year;
- Formation of an expense report for each process $З_{процесс i}$;

Calculating the efficiency of the i-th analyzed process (carried out usually quality service institution) according to the following formula [5]:

$$Э_{процесс i} = P_{процесс i} / З_{процесс i}, \qquad (4)$$

where $P_{процесс i}$ - effectiveness of the *i*-th process, $З_{процесс i}$ - programming costs for each *i*-th process.

Evaluate the effectiveness SKMK $Э_{смк}$ to the following formula:

$$Э_{смк} = \sum_{i=1}^{N} Э_{процесс i} K_{процесс i} 100\%, \qquad (5)$$

where $K_{процесс i}$ - weighting coefficient (importance) *i*-th process; N - number of processes.

Weighting coefficients $K_{процесс i}$ *i*-th process are determined by the expert method, involving experts from the staff of the university, authorized by quality, responsible for business processes and/or other interested parties. Here $\sum_{i=1}^{N} K_{процесс_i} = 1$.

Rate dynamics of the performance of processes and Scum from senior management on the basis of the relative efficiency of the processes $Э^{отн}_{п}$ and system $Э^{отн}_{СМК}$, equal to the ratio of efficiency of the process (for the system - Scum of efficiency) for the analyzed period (it may be a calendar reporting year or semester) and the efficiency of this process (for the system - Scum of efficiency) for the previous period.

Assessment of the relative efficiency of the process (Scum) held:

1) if $Э^{отн}_{п} > 1$, ($Э^{отн}_{СМК} > 1$), then the efficiency of the process (Scum) - high, the findings of the evaluation process efficiency (Scum) - needed to achieve the goals of maintaining and further developing the Scum of the development of preventive actions;

2) if $Э^{отн}_{п} = 1$ ($Э^{отн}_{СМК} = 1$), then the efficiency has not changed is necessary to maintain and achieve the goals of further development of Scum of the development of corrective and preventive;

3) if $Э^{отн}_{п} < 1$ ($Э^{отн}_{СМК} < 1$), then the efficiency is low, should be taken by senior management organization management decisions in the field of quality management improvement process and Scum and develop corrective action.

Measure of the relative efficiency will enable the senior management of the university or the head of the structural unit to take appropriate measures to address the identified gaps and make adjustments to the management policy.

Evaluating the performance and effectiveness of Scum and performance evaluation process should be conducted analyzed service quality division of the university, and a synthesis of evaluation results - authorized for quality and / or responsible for business processes - a division of the university and the quality of service in every structural unit of at least 1 times year.

13 этап. Publication on the website of the university and its subdivisions results achieve the objectives plans intrahigh processes for each activity, as well as an assessment of the effectiveness and efficiency of processes and Scum.

14 stage. Meaningful analysis of the functioning of the university planning process. Achievement and subsequent evaluation of effective planning intrahigh activities as a function of predetermined control QUM in implementation:

- Guiding rules, planning principles, which govern the formation, validity, compiling and organizing the development of planning documents and activities;
- The extent to which the target values of performance goals intrahigh actually processes the results obtained;
- High level of efficiency and effectiveness of processes and intrahigh Scum.

Table 3 presents data on the evaluation of vnutrivuzovskoy planning system.

Table 3 - Status vnutrivuzovskoy planning system depending on results of operations, the extent to which planned objectives processes

Relative efficiency of the process and Scum / Efficiency of the process and SCUM	High $Э^{отн}_{п} > 1$ ($Э^{отн}_{СМК} > 1$)	Not changed $Э^{отн}_{п} = 1$ ($Э^{отн}_{СМК} = 1$)	Low $Э^{отн}_{п} < 1$ ($Э^{отн}_{СМК} < 1$)
High (100 or higher)	IO	sustainable	-
Good (80-100)	sustainable	smarter	-
Average (satisfactory) (60-80)	average reliability	average reliability	unsatisfactory
Low (40 - 60)	-	undependable	unstable
Unsatisfactory (40 and below)	-	unstable	unstable

The stability of the process vnutrivuzovskogo planning is the ability to adapt and the planning system to maintain its current state in the presence and impact of internal and external influencing factors. Sustainability of vnutrivuzovskogo planning is inextricably linked with the stability of AFB and is characterized by the type of interactive planning. Instability of the system indicates the need for fundamental changes vnutrivuzovskoy planned policy , adapting it to the constant changes in the environment , focusing on stakeholder requirements of the university, and strict control of the leadership for the achievement of planned objectives of processes subsequent reporting period. Reliability as the quality criterion vnutrivuzovskoy planning system lies in the ability of the system to fulfill its function for a specified period of time under certain set of organizational, financial, technological and other economic conditions.

Reliability vnutrivuzovskoy planning QUM comes from preaktivnogo approach and aims to develop the core activities of the university.

15 stage. Development of corrective and preventive actions, making them in planning documents on the basis of evaluation of the effectiveness and efficiency of processes and systems intrahigh QUM and the degree of achievement of the planned objectives. Development and adjustments to the planned policy of the university.

16 stage. Storage planning documentation QUM in order to fulfill the cycle PDCA.

Implementation of planning activities within the university QUM should be checked for self-university for the successful passage of the state accreditation of the university and educational programs during the inspection audits and other audits.

Introducing a new model of the through key planning and support activities in the system QUM create the necessary prerequisites for the effective operation of the institution (and its subdivisions), allow to set and clarify the purpose of his (and their) development, creating conditions for improving the quality of educational and other services intrahigh.

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NON-ECONOMIC COERCION TO WORK WITH EFFECTIVE ECONOMIC PERFORMANCE OF THE RUSSIAN PRISON SYSTEM

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In this article the problem of contradiction, archaic methods of forced labour and of the principles of modern civil society, the ineffectiveness of legal-patornalistskoj model in relation to economic output. The author argues against the conclusions based on the analysis of economic activities of one of the existing colonies in the country. Proposals for reforming the economically burdensome for the State prison system implies an integrated approach to solving the problem: demilitarization, reduction of staff, the transition from Chamber to form of barrack, an increment of human capital, financial investments through innovation, skilled marketing research and focus on the local market.

Keywords: enforcement, jail, economy

Non-economic coercion is a direct form of forced labour, based on personal dependence direct manufacturer (manufacturers) from any person (group of persons)[2; 3]. Today the non-economic methods of forced labour are reflected in the practice of the prison system.[13] .If project a labor of convicts on the formal and informal rules of the relations of production in the market system, there is the obvious inequality test heavy physical work at a prehistoric means of production and meager value for him. However, inherent in the USSR non-economic coercion, was justified in terms of the construction of a number of large industrial and transport facilities, cities, maintenance of military needs (according to some historians the GULAG in average accounted for three percent of gross national product), while in the modern Russian penitentiary system of government demand not. Under the socialist system, the prison was characterized as cheap labor is worth to note that like any exploitative labour, in comparison with the civil sector, prison labour was ineffective, and productivity is null and void. In particular, the head of the Gulag Nasedkin may 13, 1941, wrote that «output per worker in the Gulag in construction and erection works 23 roubles per day, and in the civil sector in construction and erection works 44 ruble»), under capitalism unnecessary, moreover, burdensome from an economic point of view[4; 204].

With the change of the exploited categories - slaves, peasants, victims of the Gulag, migrant workers - the results of non-economic methods of forced labour remained low, not justifying myself with financial and moral side of the level. In our time is low, losing

productivity (growth index of physical volume of production -89%, number of not performing to standards 98% [13], outdated, uncompetitive products in prisons.

The solution is either the abolition of полубесплатной, ineffective activities of convicts, i.e. non-economic methods of forced labour, either in the implementation of mechanisms to achieve real economic results. If the colony does not pay off, cancel a prison? What causes even the temporary elimination of the threat of prison punishment is proved by the events of the 70s in one of the cities in Canada. This curious experiment showed that 5% to 10% ready at any moment to commit a crime is the so - called potential prison. And almost 20% of those who are willing to commit it, if the risk of punishment will be reduced to zero. In the end, modern society is potentially a crime, and constantly teetering on the brink of a massive, epidemic violations of the law[3; 19]. Cancel prison we cannot, for objective reasons, but reducing the prison population (Russia occupies the 2nd place in the world - cheer 1 million people), we will economize budget funds (the Treasury replenished with taxes, people contain criminals)that can be directed on implementation of innovative technologies in the system of penal sanctions. You need concentration of material resources and public services on the most dangerous for human directions [5; 45] and greater tolerance for «traditional» crimes (domestic). About 50 % of crimes committed on the soil of alcohol and drug intoxication, these criminals need not in custody, but a powerful psychological rehabilitation and medical treatment. In Russia, the average duration of imprisonment of 3 years, during this time petty offenders absorb криминагенную environment hardened criminals, which ок.15-20%, and after the liberation, raise the level of relapse.

According to article 39 of the Criminal code of the RF, to persons convicted of committing a crime may apply to the following alternatives to imprisonment penalties: a fine, deprivation of the right to occupy certain positions or engage in certain activities, involvement in public works, corrective works, restriction on military service and restriction of freedom. In the stage of nomination and execution of punishments can be applied: a suspended sentence, conditional early release from punishment, no replacement term of punishment with a softer punishment, deferment of the serving of the punishment to pregnant women who have small children. Should work diligently to develop the Institute of reconciliation of the parties. Suppose that a person committed a theft. The police detained him, the property is returned to the victim. If the victim has no more claims to the thief, maybe do not need it to send several years in the colony? It seems that the more carefully and more strictly necessary refers to рецидивистам. Who has committed a crime and has got, probably it will be enough. That done, tomorrow, without even changing legislation would reduce the number of inmates per quarter [10; 12].

House arrest as a measure of punishment is especially true for juveniles, 90% of which appear in jail caught for stealing mobile phones. A person sentenced to restriction of freedom can stay at home and even go to work, but it will be subject to several restrictions, mainly related to the change of place of residence, work and travel outside of the locality. For the control of persons convicted to restraint of liberty may be applied such means of supervision as "electronic bracelets". Representatives of the Federal penitentiary believe that imprison the "electronic bracelets can be 30-40 percent of persons convicted to restraint of liberty. Who made a small offense and does not represent a threat for the society, will have to spend two months in administrative detention, to pay a fine place broom street, повыносить pots in a shelter, the cleaning of city and surrounding areas, landscaping, cleaning and planting of greenery, construction of children's playgrounds, work in hospitals and nursing homes. In the West there was a precedent, when a young man for drunk driving was sentenced to work in the emergency room for 200 hours him to see what tragedies can result from accident, committed through the fault of drunk drivers. «The list of places for the execution of sentences was created individually. For example, work on the chocolate factory, directed woman there and worked,

was the janitor, as worker... What is the meaning of it, to leave, to perform similar work elsewhere? In the kindergarten has been appointed to work the man who was there as a janitor. With regard to schools, then it isn teenagers. They committed a crime, but the Director has agreed to take them in their school that they ennobled territory. List were given the personalities of the convicted, sent to these enterprises», - quotes the head of the press service of the regional administration Denis Vinokurov «Komsomolskaya Pravda».

Ultimately, thanks to the use of alternative measures of punishment, the number of inmates in Russian prisons should not exceed 300-350 thousand people is a limit which can «afford» to the state. The diversity of the penitentiary institutions in Russia should be only two kinds of prisons:

- Federal prison for convicts sentenced to life imprisonment; for women, convicted in case of especially dangerous criminal recidivism; for convicts from among former employees of law enforcement bodies.

- Regional prison for men convicted to imprisonment for the women sentenced to deprivation of freedom; for persons sentenced to imprisonment of persons under the age of 21.

Will work and prisoners colonies, but their work may not be as socially useful. In the beginning of this year, the President said that the industrial base of the Russian colonies and prisons needs to be optimized. Even despite of rich product range (120 thousand titles)that produce detainees, not all of them are in demand on the market. Currently, the FSIN is simply not enough demand for its products by the state. Another problem is that the system of correctional institutions today practically does not provide for the involvement of prisoners to work on modern specialties. But those same computer specialists who could provide FSIN assistance in the transition to electronic document management, sits a lot of[7; 6].

Economic performance is measured not only in monetary terms but also in the share of human capital. In this case, the Cheka will be expressed as a physical health (healthy body and spirit), power (ecology of the soul of man lies primarily through the «purity» of food), the charge of mind (after labor reading is the most valuable and powerful tool to repair person), regular social communication with relatives, implementation in the creation and sport (coaching the power of the spirit, his membrane), sexual unloading.

In my opinion, the Federal penitentiary service may contain themselves and provide favorable conditions of the prisoners, forcing them to work not only on the physical manufacturing, but with the use of creative and mental potential of convicts (a little) - music bands, theatrical performances, scientific works (prison may become a jetty for purification of thoughts and creation) and etc. of Course, if we abstract from the utopian assumptions should be all the same, the situation on the local labour market. For example, the greatest shortages in the Republic in the spheres of economy: agriculture - 31.1%, industrial production and trade - 23,9%, construction - 7,6%, housing and communal services - 7%.

The acute shortage of Ufa experiences engineers, especially those engaged in the field of engineering and construction. Among workers are in great demand drivers and labourers. The main trend we are seeing now and in the coming years will only increase - at the labor market demand for technical specialists. It is connected with the General policy of the country aimed at the development of industrial sector of economy and innovative technologies, increase in volumes of new construction, the launch of the enterprises, etc. for Many years graduates preferred technical specialties humanitarian-economic and study at vocational schools and at all was not prestigious, so now qualified personnel is not enough. The flip side of this tendency is that the specialists of the humanitarian-economic profile in such a quantity, which they now produce Universities, market demand will not be.

Need IT-specialists (many employers are invited to practice or part-time students, so that after the graduation they remain employed by the company), experts in the field of logistics (due to the integration of the business in regions of high importance for effective traffic

management), builders, technical and service specialists, skilled workers (now the salary of a skilled worker with good experience may exceed the salary of the office personnel), employees of sphere of services and skilled managers. Do not fall in demand and the most in demand by employers position - sales managers, because it is from these people depends on profits of the company, and the number of experienced and talented sales managers are not so great [11; 3].

Prisoners with disabilities may also engage in socially useful work, the lump earning money for household needs, for example the collection pens for the state or by private orders, in General any kind which does not require any physical efforts, activities.

Many prisons for more livelihood use barter scheme. For example, a local farmer may need to repair your equipment. Then he speaks in prison and in exchange for repair of the equipment offers its products. Barter is widely distributed in Russia, and the emergence of such schemes around the prison is not surprising; but it shows what an important role was playing the private sector (relative to the nonprofit format) in providing prisons resources.

On the other hand, the barter exchange with the prisons brings an interesting aspect in the notion of social justice. This can be considered a new form of social integration of the local community informed of what is produced in prisons, and prison staff actively supports barter with local residents. It checks the practice widespread in Britain opinion that joint activities between the prisoners and the local people are helpful.

A novelty in the system of employment of convicts bring the idea to monitor regional labour market with the help of the reference book of organizations Double gisa - simple, economical, efficient for search and maintaining relations with potential employers. For availability of application of the above proposals in practice, I would like to arm themselves with relevant today cameras. First, it is a great way to demonstrate to employers discipline and skills, opportunities for prisoners. Secondly, the measure of restraint illegal, inhumane actions by prison guards. Still offenders serve their sentences in отрядному or army principle. With them are still working people in uniform with almost military psychology, which are often infected syndrome struggle with criminals. These same staff in uniform carry out investigative measures in relation to persons that have committed violations of the regime of serving the punishment, contrary to international standards. All this should be changed. It is necessary to ensure a gradual transition from the mentality of the officer and the controller to the behavior of the teacher and the teacher [8; 8]. Management should be based on science, not on order. All senior managers must become managers to better cease to be officers. Prison is not the battlefield. The Director should become a leader who inspires subordinates and prisoners, he is responsible for the climate, for the spirit in his prison[9; 12]. In the main part of jailers required castling on psychologists, social workers, medical staff, and the small number of protection for the organization. These people depends on the quality of reforms in the penitentiary system reform.

Prison staff should be managers for the direction of the investment flow in prison, the acquisition of modern means of production, the creation of all the material conditions, competent marketing and psychologists for permanent activation of consciousness (as he wrote J.. Orwell in the brilliant work of «1984» - «Reality exists only in our minds», i.e. the way of forced labour continue, but on the level of mentality, the convicts will be perceived as encouraging. Interested work is the best means for rehabilitation of convicts. Whenever a person is in a critical situation, must think and act in order to be able to resolve its own problems. The task of managers is to give a needy person the knowledge, indicate the method of conduct, help strengthen find hope and lost faith in themselves, a sense of self-pride. These characteristics have in the biographies of unemployed persons, alcoholics, drug addicts, homeless people, recidivists, former criminal offenders, victims of violence often have long lost their value. They should recover fully or at least partially, that will allow these people to act independently. Any measure of independence is important as it allows the individual to take

responsibility for your life [6; 34]. In the Scandinavian countries perceive criminals rather as patients, the main punishment consider the limitation of freedom. And have only 20% of relapses. At the other pole of the USA and Russia, where correction is based on punishment and violence, this figure amounts to 50-70%. [12; 16] However, to the staff of UIS began enthusiastically implement various innovations in respect of convicts will not be solved until their urgent problems of wages, conditions of performing their official duties, housing, the right to free travel, free meals on duty, and decent work-based pension schemes. In short, to make comfortable service staff and raise the prestige of this profession. Recently, the Minister of justice Konovalov promised that in the future the system of execution of punishments will work fewer employees, but their incomes are much higher than now. Also proposed a shift system is often based on military style shift systems, for example, working continuously for 24 hours and then having three days off. Employees may Supplement low incomes by additional work part time. In a professional prison service, where staff are expected to do more than just guard, 24-hour shifts are unacceptable. [1; 5] For the maximum efficiency of cooperation between the two sides, it is also necessary to reconstruct the colony, i.e. барачное content in the chamber. Instead of the labor army prisoners in 500-600 people cameras 4-6. First, it is immediately torn some negative communication between persons belonging to a criminal environment. Secondly, it is much easier to oversee, and most importantly - load educators, psychologists and social workers will decrease in 10 times that will achieve real results in the sphere of increment of human capital and financial results of the institution, payback prison, economic feasibility mechanism.

Problems of the prison should not be perceived by the society as something abstract, and it is not in the moral communion, the compassion of the prisoners of this system, and in the economic recoupment, decline. Entire prison system, convicts are held by ordinary citizens of the state, moreover, the financial burden in Russia is the highest in the world. History does not remember the examples, when forced labour would be economically justified. Work by definition can not be under pressure, as this is expedient human activity. The solution to this dilemma can be presented as a formula: the economic results of the non - economic coercion to work, i.e. to compensate the exploitative nature of work effective stimulation, humanism, therapeutic environment, training of employees, high profitability, sales of working hands, minds, output and capacity. Processes demilitarization of staff, reduction of the number of convicted, competent management and marketing researches are able to translate the productive forces, economic results, and in General, the current Russian prison system to a qualitatively new level required by a market economy.

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PROBLEMS OF LANDSCAPING IN MOSCOW: NEW OPPORTUNITIES IN THE SETTING OF INFORMATION TECHNOLOGY APPLICATION

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The article investigates the landscaping of Moscow. IT-technologies are seen as a means to optimize the creation of landscaping projects. It also includes a characteristic of some software tools used for solving practical problems of landscape design and landscaping of Moscow.

Keywords: landscaping of Moscow, design of landscaping objects, IT.

Green spaces are an integral part of Moscow. Along with the architectural landscape gardening objects participate in shaping the city. They are of sanitary, recreational, landscaping, architectural, cultural and scientific significance. However, addressing landscaping problems in a metropolis like Moscow has a number of difficulties.They include: intensive residential development, a complex transport system, many industrial facilities, a large number of underground utilities and facilities in the area of the root system, presence of stone, concrete and metal surfaces, asphalt pavement of streets and squares, additional lighting on plants at night, unfavorable environmental situation in the city (increased gas pollution, dust and smoke is air, soil, water), etc. [3]. It is essential to mention the dramatic changes in the urban infrastructure that are taking place now, like intensive construction of roads, tunnels, new subway stations,extension of building in New Moscow, etc.In connection with constant changes on the green areas of the city take place, which requires regular and timely data correction. All this requires a search for new opportunities for landscaping and beautification of urban areas in the modern metropolis under rapidly changing conditions.

Works on the landscaping and beautification are based on design solutions, including proposals on the dendrological part of the project. In our view, modern IT can serve as a means for quick creating landscaping projects and new areas of Moscow, as well as reconstruction of existing urban areas. In this regard, use of modern software and hardware, as well as information technology becomes relevant for creating dendroloical projects.

The work of dendrologists and landscape designers requires knowledge of the biological and ecological characteristics of trees and shrubs; of the fundamentals of design taking into account the peculiarities of the plants, as well as the external influences on their growth and development. It is also necessary to form the skills of application of IT in solving practical problems of landscape design and construction.

In landscape design,software tools of information technology are now widely used [1]. Among them the raster graphics program Adobe Photoshop. Adobe Photoshop is an advanced graphical editor for working with bitmaps. Adobe Photoshop is the market leader in commercial bitmap editing tools.

It supports numerous graphic formats, and can be used both for creating new images and editing others.When dealing with any images in Adobe Photoshop you can use color correction, transformation of any complexity, retouching, working with text, use various filters and effects that can replace the background, work with layers, save graphics in 2D, 3D, HD quality and more .In addition, it allows you to use vector graphics, for example, to insert text in the image. One of the additional features of the program is the animation.

3D modeling program Google Sketch Up is used to create models of landscaping area, elevation models, small architectural forms, etc. Google Sketch Up is an application for three-dimensional modeling, which allows you to create a variety of 3D models.Objects created in this program consist of two main elements: edges and faces. THe former are presented by straight lines, and the latter by 2D shapes formed during the formation of a plane contour with several edges. Building models in Google Sketch Up includes drawing edges and faces with a few simple tools.Everything created in the application has exact dimensions, so the user has the ability to shape the models as accurate as possible, consistent with their requirements. In addition, scaled models can be printed. Uniting the geometrical parts of the model and the formation of groups allows you to create sub-objects that are convenient to move, copy and hide. Copies of the components are associated with each other, so a change in one copy is automatically displayed on all the others. THanks to this the trees, windows, chairs, doors and many other items are more perfect. Google Sketch Up incorporates a real-time mechanism for creating shadows, which allows you to add accurate shadow effects to the models.The program provides an opportunity to look inside the created model and to examine it using simple tools. In Google Sketch Up an archive of 3D models is available, consisting of a three-dimensional interactive database objects that you can use when searching for a particular model.

AutoCAD for many years has been one of the most popular design tools.It is a powerful, functional and at the same time easy tool that can be used by architects, engineers, designers to implement various projects.

One of the main functions of the program is to create a variety of drawings, it significantly reduces the time you need to check drawings.The program allows you to create different tables to export and import data from MS Excel, as well as work with various text inserts.

A distinctive feature of this program is the very user-friendly interface that allows you to zoom in or out on a computer screen, using the pan. Besides the basic functions, the program can effectively bind programs to graphic objects, as well as other objects that can be stored in an external database using links.An engineer who works in the program AutoCAD can print multiple drawings. The most recent versions of this program effectively use possible three-dimensional design, which allows you to view the model from any point, check the interference and export the model for creating animation, as well as export production data and produce technical analysis.

Terragen is a program for generating landscapes. You can create a landscape and preserve it as an image. It will allow you to use the created image as the background when working in landscaping programs. Terragen allows you to customize the rendering of the landscape, relief, determine the point of illumination.You can preview the generated landscape. With this software, you can configure certain parameters of the future landscape.

The author's experience as a dendrologist engineer in a Moscow design organizationallowed to get acquainted with the peculiarities of design tasks given the changes in landscaping objects.

In Moscow landscaping and beautification system, ornamental trees and shrubs are used as major components in creating green areas.Selection of trees and shrubs for planting in the city is dominated by biological features of plants, including plant height, speed of growth, shape of the crown, decorative features related to seasonal and aging changes (shape and color of leaves, shape and color of fruit, etc.).No less important are the environmental properties of plants.In this connection resistant, durable and decorative trees and shrubs should be selected for planting. When creating green spaces, one need to consider their purpose. Plantings can satisfy both hygienic and aesthetic requirements, perform protective functions: they have dust properties to protect the air from pollution by noxious gases, create noise protection.

When designing the urban landscape one should consider the main types of trees and bushes planting: alleys, lines, solitaire (single landing), hedges, buffer zones, groups (clumps), and arrays. Creating a dendrological landscaping project in practice is associated with taking into account the features of the gardening objects. The main categories of gadrened territories in Moscow are: construction of new landscaping common areas (parks, gardens, squares, boulevards, landscaping highways and streets), reconstruction of public landscaping, landscaping of residential areas, reconstruction of greened areas in established districts. [2]

When designing landscaping and beautification objects results of monitoring of vegetation are taken into account: assessment, causes of damage, resistance to pests and diseases, etc.

The changes on the objects are recorded in the tally sheet after examining the plot on which they are to be built.

Then the tally sheet shuld contain the number of trees and shrubs, the species composition, condition, presence of lawns, grass cover, flower beds.

Among the software tools that significantly streamline the activities on creating arboretum section of landscaping ofMoscow, we can note a program developed by "NEOLANT", which is designed to account for green spaces.

The program provides the following options:

- Manage spatial data sources (custmizing *DGN* to *iDPR converting);*
- Manage maps, layers, and spatial data services *(WMS* web services publishing);
- Project management;
- Manage users.

For each project registered in the system, you must configure the mapping subbase. It is done manually and is part of system administration.

With this program you can perform the following activities.

1. Draw objects on the plan, namely the draw: a point object (tree, self-sowing, seedling), a group of point objects (e.g., a group of self-seedings); polygonal object (bush, scrub), a group of polygonal objects (e.g., a group of shrubs) , notes on the plan (if you want to save green spaces along the edge of the working area).
2. Editing items: editing attributes (state changes in tally sheets), editing polygonal object, namely moving nodes, adding nodes, resizing, selection of point objects from the group, e.g. you must select two of the five trees, isolating groups of polygonal objects if you need to separate several shrubs from the group; partition of a polygonal object; changing the style of the object, i.e. specifying a different conclusion (cut down, save or transplant); defining style for new objects.A default conclusion can be chosen for the created object, move the object, i.e. the possibility to move a tree or a shrub to another location on the plan; removing objects.
3. Work with callouts: d Adding standard callouts to the object.A standard callout connects a user-selected object and the callout with a straight line; Adding an angle callout to an object.An angle callout connects the user to the selected callout with a zigzag; adding callouts to all objects or auto-callout; moving callout throughout the plan (near the objects), editing callouts near notes, namely moving, changing the length of the line, changing the

location of the breakpoint, adding breakpoints, removal of callouts for all objects, removing the object leader, change the angle - the angle of rotation changes the callout text rotation angle.

4. Working with sheets: Adding a tally sheet.Add a new sheet and then fill it in (breed, minimum and maximum height and diameter, condition, features, conclusion, etc.), editing attributes of a tally sheet (for example, change the conclusion or the height). Deleting tally sheetsBasic tally sheet cannot be removed; split a tally sheer into several sheets, and Importing objects into a new project.Transferring data from one sheet to a project whose objects will be imported into the current project.

Thus, in recent years in Moscow has been noted a tendency to improve the quality of landscaping works. For solving landscaping practical problems information technology is used. Modern software and hardware can serve as a tool for optimization of designing landscaping projects of Moscow.

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PROBLEMS OF FORMATION OF LABOR POTENTIAL OF THE REGION

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Annotation. The article examines the theoretical aspects of the formation of labor potential. Analysis and estimation of the labor market of the Republic of Bashkortostan. In compliance with the prospect of the skill needs in the region, given the direction of professional training.

Key words. Labor potential, innovative potential productivity.

Appointment of labor relations in modern society is to maximize the employment potential and worthy of its payment system. The problem of labor activity in the socio-economic subsystem labor potential occupies a leading position. It is characterized by diversity, nature of work , the system of material incentives and motivational structure of economic behavior.

Availability of modern economic thinking, aimed at innovative economy - an essential structural element of the modern economy. The modern system of values must implement it and form an adequate labor potential, with new qualities.

Importance of education for social development today recognized the political elite and business circles of the leading countries of the world. We are talking about the formation of the so-called "knowledge economy", when investment in knowledge are seen as a key factor in improving human resource capacity, the transition to full employment, personal growth and profits population welfare state.

Sine qua non of modern production is the availability of highly qualified and skilled personnel. Prospects of development of modern economy and society determined by the level

of intellectual development of society and its professional preparedness that increasingly depends on education in general, and from vocational education as an integral part thereof. [2]

Vocational education has two functions in society: economic (production) and social. First, vocational education acts as a factor of economic development, engaging reproduction of skilled labor, thereby developing production potential. In the second case we are talking about prevention of unemployment and social instability, vocational training meets the needs of people in education.

Now we can observe a tendency that education throughout life is the norm, the ability to continuous learning is part of the labor potential.

Nevertheless, education requires significant investment: financial, labor, material.

Table. Dynamics of employment and unemployment in the Republic of Bashkortostan for 2009-2013

Year	**Economically active population**	**Number of employed**	**Number of unemployed**	**Total unemployment**
2013	1 998 200	1 883 000	115 200	5, 81
2012	2 042 000	1 918 000	124 000	6,07
2011	2 080 000	1 921 000	159 000	7,63
2010	2 040 000	1 858 000	182 000	8,92
2009	2 071 000	1 880 000	190 000	9,19

As can be seen from the data on the labor market situation in the Republic of Bashkortostan is not stable. And in recent years there has been a positive trend. Level dynamics for 2009-2013, changed from 9.19-5.81% [3]

Table. Demand for workers by industries in the Republic of Bashkortostan in 2013[1]

Branch of the economy	**The need for workers, %**
industry	15
agriculture	3,8
transport and communications	4,3
construction	13,8
trade and public catering	10,3
domestic services	5,9
management	2,2
health, social welfare, education, culture, science	13,3
other industries	31,3

Drawing. Demand for workers by industries in the Republic of Bashkortostan in 2013[1]

The labor market of Bashkortostan traced structural unemployment, where there is a mismatch structure jobs (demand) the labor force (supply) in the labor market because of such factors as education, age, gender, profession, qualification.

In planning the current staffing develops a number of proportions: the socio- economic, territorial, sectoral. Socio-economic proportions represent the proportion of the economic costs of education and training, the ratio of the number of students and the general population, the number of students being discontinued and the labor force. If we talk about territorial proportions, they represent organize educational institutions in the region. Determine the structure of industry in training between sector, the relationship between general and vocational education .

When predicting vocational training must be clear of the main directions of development of education in the region. Development of education in the region must be submitted by the following concepts:

- Maintain the required proportion between the number of qualified personnel in the field , by industry , the ratio of required specialists with specialized secondary and higher vocational education;

- Determine where the necessary skilled personnel , the ability to move them if necessary by region ;

- Coordination between the different types of training , retraining , or the possibility of substitution. [2]

In the future, the structure of training qualified personnel should be reflected in the demographics of the region: the age and sex structure of the population is in pre-retirement age, the number of young people entering the world of work. Of fundamental importance is also orientation training, planning for the future needs for skilled workers over the next 3-5 years and in the long term.

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METHOD OF PREPARATION AND ANALYSIS OF DATA COLLECTED DURING THE EXPERT INTERVIEW

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The article describes the method of preparation and analysis of expert information based on fuzzy sets. The degree of experts' confidence in each of the answer options is taken into account and provides more accurate generalized predictive estimation reactions of economic and social systems on the possible control actions. A mathematical model for determining the competency of experts as a directed weighted graph allows to calculate the level of competence of the respondent for each question in the questionnaire separately. In the analysis of expert information verified significance level expert's attributes affects competence in the subject area, which together with the above mentioned can improve informative conclusions derived from the data in expert interviews, and as a result, the reliability of the predictive estimation of system reactions response to potential manipulated variable.

Key words: economic and social systems, expert estimation, preparation and analysis of expert information, degree of expert's competence, predictive estimate of system reactions.

Complexity of economic and social systems is due to the strong influence of random factors on the control object, a small study of their reactions to specific control actions, the presence of significant synergies, as well as difficulties organization monitoring the behavior of such systems. In addition, in economic and social systems there is an anthropogenic factor that is of the non-statistical nature. All this does not allow to adequately study the processes taking place in the economic and social systems, methods of mathematical statistics, difficult to assess the representativeness of the sample and study the behavior of the system when changing the projected object, all of which leads to significant errors resulting in predictive estimations in control of complex systems . Therefore the management of economic and social systems use methods of expert estimation. Thus on what methods were carried out data collection and processing expertise, will depend on the reliability of the predictive estimation of system reactions of the possible control action.

Significant contribution to the study of the economic and social systems is made by D.A. Novikov. He made an attempt to integrate this issue in the general theory of control components and systematically describes the main types of relations between them. Great importance in the subject area are unemployed and T.L. Saaty, who proposed the theory the use of which reduces the study of complex systems to the sequence of pairwise comparisons appropriately defined components. Results in the development of corporate systems, methods and algorithms for data analysis are widely represented in the works of A.A. Barseghian, M.S. Kupriyanov, V.V. Stepanenko, I.I. Frost, E. Lehmann, F. Kotler, D. Hawkins, A.V. Aleshin, I.S. Beliavsky, I.V. Gorbach, A.B. Berger, B.F. Anderson.

Analysis of these studies showed that during the expert interviews the competence of the respondents in the subject area is often not taken into account [1]. Part expert information will be lost as insufficiently taken into account the views of experts who may be slightly different in the degree of confidence predictive estimatшщт of the economic and social system reactions on the possible control actions. Based on the analysis of existing software for collecting and processing data, such as «Analysis Services» and «Excel» company Microsoft, «Data Mining» company Oracle, «Deductor» company BaseGroup, web-services «ProstOpros» and «WebAnketa», deficiencies in the processing and analysis of expertise were revealed,

which are a consequence of low information data, as it does not take into account the degree of confidence in each of the expert answers, not fully and accurately estimated the opinions of experts who have several differing in the degree of confidence forecast estimates on the possible reaction of the system control exposure. All this, in its turn, reduces the effectiveness of management decisions based on the results of data processing expert interviews. Thus, improving the procedures for the collection of expert information processing techniques and data analysis expert interviews to develop effective solutions for managing economic and social systems is an urgent task.

To implement it, a process approach to the survey process developed, characterized by the presence of existing processes further processing of the results of expert estimation during their multivariate analysis to management decision-making [2]. Expert information collected by the survey system is transformed into a multidimensional aggregate data storage [3, 4, 5], the analysis of that test significance level experts attribute affects competence in the subject area, and the degree of certainty considered an expert in each of the options, which allows to improve information you wires derived from data in expert surveys. Elaborate on the method of preparation and analysis of expert information, consisting of the following steps: preparation of an integrated assessment, obtaining expert information, determine the degree of expert's competence, obtaining a generalized opinion of the expert group, to obtain a clear quantitative survey results.

Step 1. Preparation of integrated assessment. Usually in older literature is recommended to use the arithmetic mean of [6, 7]. This method is not correct, because points are usually measured on an ordinal scale. It is reasonable to use medians as average scores. However, to completely ignore the arithmetic mean wasted due to their familiarity and prevalence. It is therefore advisable to use both methods simultaneously – the method of arithmetic ranks and methods of median ranks. This recommendation is consistent with the concept of sustainability, according to which use different methods to handle the same data in order to highlight the conclusions obtained simultaneously for all methods. These findings correspond to reality, while the conclusion, changing from method to method, researchers depend on subjectivity, choose the method of processing raw data, for example, expert estimations.

Figure 1 – The structure of the data analysis

After statistical analysis of data should be obtained integral evaluation on the results of the survey (Figure 1). For integral estimates used analytic hierarchy process, allowing on the basis of pairwise comparison matrices given by experts, a vector of priorities [8]. Consistency condition selected matrix is checked by the formula: $O_c = \frac{I_c}{C_c}$, where I_c – consistency index matrix ($I_c = \frac{(\lambda_{max} - n)}{(n-1)}$, where λ_{max} – maximum eigenvalue, n – its rank), C_c – random consistency index. If O_c does not exceed the permissible value γ, then further normalization

of the eigenvector matrix selected, and then formed the weights vector $\bar{\alpha}$. Vector estimation values calculated by the formula:

$$NormRes = \frac{[\bar{\alpha} \times Otv]}{\alpha_{max}}, \quad (1)$$

where Otv – matrix expert answers, α_{max} – maximum weight.

The advantage of the hierarchical structure of data analysis is the possibility of dividing the problem into its component tasks and focus on the interpretation of the results separately analyzed component.

From the values of the variables that describe the properties of objects are allocated a group of similar experts [9]. The first thing you need to know – how many types in the sample it is advisable to allocate. On a selectable segment results are achieved in data analysis, more significant of which is the union of objects in the group taking into account measures of proximity to each other. Using cluster analysis also solved the problem of reducing the dimension of the data [10]. To solve this problem, a method of classification tree (CT) [11] (Figure 2).

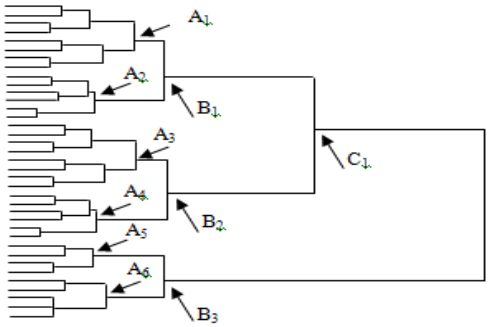

Figure 2 – Presentation of results CT

Now that the whole sample is divided into a number of groups within which the experts are very similar in their characteristics. As a result, the entire sample is combined into a single cluster. The example shows that it is possible to allocate:

– the largest number of clusters (A_1-A_6);
– average number of clusters (B_1-B_3);
– the smallest number of clusters (C_1).

Then calculated the arithmetic means of the characteristics of experts for each cluster.

Step 2. Getting expert information based on a mathematical model for determining the competence of experts. To construct it, we use the theory of fuzzy sets, because the judgment (estimation) experts are subjective [12]. Suppose that in a poll of experts taking part *K* and *P* profile contains questions. Expert selects several quantitative assessments are included in the questionnaire and match his understanding of the selected answer. To facilitate the task degree of confidence in the answers to the questions posed experts use verbal and numerical scale Harrington (Table 1).

Table 1 – Answer the *k*-th expert on the target *p*-th survey question

№ expert	Possible values change performance indicator, %						
	-75	-50	-25	0	25	50	75
1	0	0	0	0,3	1,0	0,8	0

Each trust matter contained in the questionnaire, is associated with a linguistic variable L_i $(i = \overline{1,P})$, whose values are answers

L_{ij} $(j = \overline{1,J^i})$, where J^i – the number of answers to the *i*-th question. Value of linguistic variable is described as a fuzzy set, which is defined on the base (clear) set of real numbers

$U_i = \{u_{is}, s = \overline{1, S^i}\}$, where *s* – the whole possible range of estimates of the linguistic variable L_i. So much for the *i*-th question set is defined as:

$$U_i = \{u_{i1} = -75;\ u_{i2} = -50;\ u_{i3} = -25;\ u_{i4} = 0;\ u_{i5} = 25;\ u_{i6} = 50;\ u_{i7} = 75\}.$$

Result comparison of each of the above assessment of the set with a quantitative indicator of the degree of confidence – is the value of the membership function. The membership function $M_{L_j^k}(u_i)$ ($i = \overline{1, P},\ j = \overline{1, J^i},\ k = \overline{1, K},\ s = \overline{1, S^i},\ u_i \in U_i$) elements of the base set of fuzzy set L_{ij} the opinion given by an *k*-th expert row vector: $M_{L_j^k}(u_i) = [\mu_{L_j^k}(u_{i1});\ \mu_{L_j^k}(u_{i2}); \ldots;\ \mu_{L_j^k}(u_{iS^i})]$.

However, an expert group one competence in practice is very difficult. In this regard, there is a need, first, to determine the degree of competence of each expert, secondly, its consideration in the analysis of expert information and obtaining generalized predictive estimate.

Step 3. Determining the degree of expert's competence. Measure of competence of the expert determined using indirect methods based on information about his professional or other domain-specific activity [13, 14]. To identify the characteristics of auxiliary tools in the expert survey included additional questions corresponding set $D = \{D^n, n = \overline{1, N}\}$. Each question D^n in line put a lot of additional responses $B^n = \{B_m^n, m = \overline{1, M^n}\}$. Forming a plurality of answers to additional questions, the answers are presented in order of scale.

To convert the answers to the additional questions in the quantitative ratios of competence each B_m^n-th variation response to D^n-th additional question is associated with a positive coefficient ρ_m^n, where $\sum_{m=1}^{M^n} \rho_m^n = 1$. The value of this coefficient depends on the number of answer to a further question, and is calculated according to the rule:

$$\rho_m^n = \frac{m}{\sum_{m=1}^{M^n} m}, \forall m = \overline{1, M^n}.$$

(2)

As a result, the choice of a particular *k*-th expert B_m^n-th variation response to D^n-th additional question unambiguously defines a set of coefficient ρ_m^n, which is denoted by η_k^n. The value η_k^n depends on all the answers to additional questions and calculated by the formula:

$$\eta_k = \frac{\sum_{n=1}^{N} \eta_k^n}{\sum_{n=1}^{N} \max\limits_{m} \rho_m^n}.$$

(3)

Impact on the level of competence of the expert fuzzy quantitative measure implemented by performing a "blurring" [15] according to the rule:

$$\tilde{\mu}_k(u_i) = \mu_k(u_i)^{\eta^k},\ \eta^k \le 1.$$

(4)

To improve the accuracy of forecast evaluation economic and social systems reactions calculates the level of competence of experts for each additional item questionnaire included in the expert survey instruments, in other words, determining the weights of each characteristic influence on the expert's competence. Checking the difference between actual experts carried out by analysis of variance (*F*-test), conducted before the use of *K*-medium: $F = \frac{\sigma_1^2}{\sigma_2^2}$, where σ_1^2 – larger variance, σ_2^2 – smaller variance. In this step, identifies important characteristics of experts in each cluster (Table 2).

Table 2 – Important characteristics of experts

Expert characteristics (*Ch*)	*F*-test	*p*-value
Ch_1	4,29	< 0,01
Ch_2	1,18	> 0,05

…		
Ch_w	5	< 0,01

p-value – a value used in the statistical hypothesis testing. In fact, this probability of error in rejecting the null hypothesis (Type I error). Testing hypotheses using alternative values is a classic test procedure through the critical value of the distri-

bution. $p(F)$ – the probability that a random variable with this distribution will exceed the value of Fisher statistics. If $p(F)$ (for two-tailed test – $2p(F)$) is more than the level of significance, then this characteristic affects its expert competence.

Upon receipt of the balance of influence on the characteristics of competence of the experts used a modified method of ranking loosely, used to define the case of generalized preferences/attributes indifference towards each other weights Fishburne (Fb_i) [16], by the formula:

$$r_{i-1} = \begin{cases} r_i, if\ Fb_i - 1 \approx Fb_i, \\ r_{i+1}, if\ Fb_{i-1} > F_i, \end{cases} r_N = 1,\ i = N, \dots, 2,$$

where ≈ – indifference relation, > – preference relation. Payments received numerators – there is a common denominator of the fractions – is calculated in accordance with rule:

$Zn = \sum_{i=1}^{N} r_i$, $p_i = \frac{r_i}{Zn}$, where $\sum_{i=1}^{N} \frac{r_i}{Zn} = 1$.

As a model in the evaluation of economic and social system to control actions (Rctn) adopted a tuple: $Rctn =< Gr, Atr, E >$, where Gr – directed graph having a single root node and does not contain loops and horizontal edges within one level hierarchies, Atr – a set of qualitative assessments of levels of each attribute in the hierarchy, E – system of preference relations attributes in terms of their impact on competence (Km): $E = \{Atrb_i\ (e)\ Atrb_j \mid e \in (>; \approx)\}$, where $Atrb_i$ and $Atrb_j$ – attributes of the *i*-th and *j*-th vertices of the same level in the hierarchy. Imposition of preference relations/indifference type: $E = \{Atrb_1 > Atrb_2;\ Atrb_2 \approx Atrb_3;\ Atrb_3 < Atrb_4\}$ on the graph fragment shown in Figure 3.

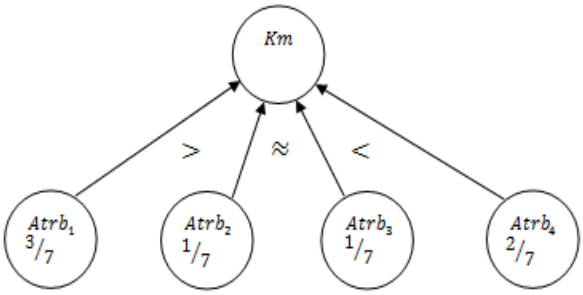

Figure 3 – Example of a relationship at one level of the hierarchy

Step 4. Getting a generalized opinion of the expert group. A survey of the set of all experts $Э = \{э_k,\ k = \overline{1,K}\}$ for each *i*-th

($i = \overline{1,P}$) question profiles obtained K fuzzy quantitative measures $\tilde{\mu}_k(u_i)$, which take into account the expertise of the experts interviewed [17]. Fuzzy set characterizing the generalized opinion of the expert group, defined as the intersection of fuzzy expert opinion has a membership function:

$$\tilde{\mu}_{Э_i}(u_i) = \min_k \{\tilde{\mu}_k(u_i)\}. \quad (5)$$

Applying the conjunction in fuzzy sets corresponding answers experts will generalized fuzzy estimate submitted by a minimal set of operands on the results of the expert survey.

Values of linguistic variables formally represented in the form (for example, 2 experts): $L_1 = \frac{0}{-75} + \frac{0}{-50} + \frac{0}{-25} + \frac{0,3}{0} + \frac{1}{25} + \frac{0,8}{50} + \frac{0}{75}$; $L_2 = \frac{0}{-75} + \frac{0,1}{-50} + \frac{0,4}{-25} + \frac{1,0}{0} + \frac{0,4}{25} + \frac{0,1}{50} + \frac{0}{75}$. Membership functions respectively: $\mu_1(u) = [0;\ 0;\ 0;\ 0,3;\ 1;\ 0,8;\ 0]$; $\mu_2(u) = [0;\ 0,1;\ 0,4;\ 1,0;\ 0,4;\ 0,1;\ 0]$, $u \in U$. By virtue of the fact that the first coefficient of competence of the expert is 1, the membership function to be adjusted, only the second response fuzzy expert:

$$\tilde{\mu}_2(u) = \mu_2^{0,3}(u) = [0; 0,1; 0,4; 1,0; 0,4; 0,1; 0]^{0,3} = [0; 0,5; 0,6; 1,0; 0,6; 0,5; 0]^1.$$

Membership function characterizing the generalized opinion of experts, is defined as follows:

$$\tilde{\mu}_э(u) = \min\left(\tilde{\mu}_1(u), \tilde{\mu}_2(u)\right) = [\min\left(\tilde{\mu}_1(u_1), \tilde{\mu}_2(u_1)\right);\ \min\left(\tilde{\mu}_1(u_2), \tilde{\mu}_2(u_2)\right);\ \min\left(\tilde{\mu}_1(u_3), \tilde{\mu}_2(u_3)\right);$$
$$\min\left(\tilde{\mu}_1(u_4), \tilde{\mu}_2(u_4)\right);\ \min\left(\tilde{\mu}_1(u_5), \tilde{\mu}_2(u_5)\right);\ \min\left(\tilde{\mu}_1(u_6), \tilde{\mu}_2(u_6)\right);\ \min\left(\tilde{\mu}_1(u_7), \tilde{\mu}_2(u_7)\right)].$$

It follows that $\tilde{\mu}_э(u) = [0; 0; 0; 0,3; 0,6; 0,5; 0]$.

Step 5. Getting a clear quantitative survey results. To obtain such an item is selected survey results u_i^*, having a maximum value of the degree of belonging to the fuzzy set obtained generalized views of a group of experts:

$$u_i^* = arg \max_{u_i} \tilde{\mu}_{э_i}(u_i). \quad (6)$$

Applying the disjunction of the elements of the fuzzy set generalized assessment, we'll get a quantitative result of unequivocal expert survey, corresponding to the maximum value of the operand, which points to a specific element of the base set U_i.

Using formulas (1)-(6), is weighted, cumulative result of a survey of members of the group of expert estimation (Table 3).

Table 3 – Processing fuzzy estimates of the expert group

№ expert	Possible values change performance indicator, %							*Km*
	-75	-50	-25	0	25	50	75	
1	**0**	**0**	**0**	**0,3**	**1,0**	**0,8**	**0**	1,0
2	0	0,1	0,4	1,0	0,4	0,1	0	0,3
2*	**0**	**0,5**	**0,7**	**1,0**	**0,7**	**0,5**	**0**	–
…								
K	0	0	0,3	0,8	1,0	0,8	0	0,8
*K**	**0**	**0**	**0,4**	**0,8**	**1,0**	**0,8**	**0**	–
Generalized estimation	**0**	**0**	**0**	**0,3**	**0,7**	**0,5**	**0**	–
Unambiguous result	–	–	–	–	**0,7**	–	–	–

* – "blurring" of fuzzy quantitative measure.

The table shows that the membership function that characterizes the general opinion of the expert group, has the form: $\tilde{\mu}_э(u) = [0; 0; 0; 0,3; 0,7; 0,5; 0]$, the generalized result of a survey of experts is the maximum value of membership function $\mu_э(u) = 0,7$. For example it means that from a group of experts with a high probability of the selected control action will lead to an increase of the efficiency of the economic and social system by 25 %.

The mathematical model for determining the competence of experts as a directed weighted graph allows us to calculate the level of reading competency profiles for each question individually, thereby increasing the efficiency of data processing and prediction accuracy by an average of 15-25 %. The developed methodology for the submission of expert information based on fuzzy sets considers the degree of confidence in each of the expert answers and provides a more complete and accurate weighted generalized predictive assessment presented in fuzzy metric economic and social systems reactions on the possible control actions. The proposed method of processing and data analysis expert survey implemented in software in the

form of an informational questionnaire system "Apofasi"(Certificate of registration of an electronic resource № 17686 from 12.14.2011.) using Web-based remote access, which works:

– in FSBEI HPE Penza State University in the management of the system of quality management. The initial value of the estimate completely satisfied with the quality of service has been adjusted to 25 %;

– in Zheleznodorozhnaya Administration in Penza region in managing the activities of local authorities. Based on the processed and analyzed data of a sociological survey administration, it was decided placement of the playground, taking into account the interests of citizens located near area;

– in CJSC PFC "Attica" (Volgograd city, Russian Federation). Based on the results of predictive estimation opinions of the expert group on the development of the parameters characterizing the residual life of the equipment an administrative decision was made to contribute to shorten the process equipment downtime and improve production efficiency to 10-15 %.

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METHODS OF PROTECTION OF THE INTELLECTUAL ACTIVITY RESULTS IN INTERNET INFOSPHERE

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The purpose of this article is perfection of using metodology of technological and legal protect of intellectual activity results and related intellectual rights in information sphere of Global Telematics Network "Internet". On the conduct analysis base of the peculiarities and possibilities of using of different ways of intellectual rights (author rights and another) protect the offers of perfection of corresponding organization and legal safeguarding are formulated. The effectiveness of protection is provided under the condition of providing its complexity on the basis of the application technological and legal ways.

Keywords**:** intellectual activity, results, protection, technological and legal methods, intellectual property, intellectual rights, information legal relation, information sphere, Internet.

Economical, organizational and legal control of turnover of intellectual activity results (IAR) includes risk management in the creation, deployment, as well as for RIA distribution [1], in particular, through the Internet Global Telematics Network.

The Internet Global Telematic Network concentrates an enormous volume of multi-aspect information: educational, scientific, informative, cultural, social and legal, political and etc. At the same time the Internet is a wide arena for "intellectual piracy" and other illegal actions, resulting considerable material and moral damage in the conditions of the development of innovation economy. There are a lot of cases of infringement of intellectual property in the Internet information sphere (infosphere), i.e. of the intellectual (copy, related, invention, patent and etc.) rights. That fact stipulates for the actuality of the multi-aspect problem of their protection, including the legal problem of proof of the infringement of intellectual rights to corresponding information objects of the intellectual property (IAR) placed on and distributed through the Internet.

There are known the methods and means of technical (individual, public, etc.) and legal (by their form: non-juridical – extrajudicial; juridical-judicial, administrative) protection (taking a complex of general and special organizational and legal measures) of the IAR placed

on (published) and distributed through the Internet in information objects form, and intellectual rights to such objects, which combined application may provide for effective protection of the intellectual rights taking into account the specifics of the global network (uncertainty of its legal status, mass character and geographic distribution of accessibility, exterritoriality and collective-"network" use of the IAR – objects of intellectual property, practical complicacy of revealing of the infringer, vague definition of the applied jurisdiction, optionality of the registration of the objects of copy- rights, etc.). Before placing IAR as the object of intellectual property on the Internet infosphere, the rightholder (author) may apply different organizational and technical methods aimed at the protection of his intellectual rights, i.e. methods of self-protection». In particular, certification (technical and notary) of intellectual rights, provision of technical security of the objects of intellectual property.

In practice, most often the process of authorship proof rests upon the so-called presumption of authorship and comes to presentation of the earliest created copy of the IAR where the author is indicated. However, if the third persons submit an earlier copy of the object of intellectual property, the right to authorship should be proved judicially. In order to avoid such situation, it's necessary to certify notarially the copy (content) of the information object of intellectual property (such service in the Internet is rendered by «net-work» notaries), or to deposit a copy in a special archive of the Web-depositary or in one of the organizations offering such service, for example, Russian Authors Society *(www.rao.ru).Itis* possible to register a program code of the Internet-site where the information object of intellectual property is placed, with Rospatent. To protect the information object of intellectual property after due certification of the intellectual rights (copyrights and etc.) it is also possible to use (in particular, according to Art. 1299 of CC RF) different means of technical protection allowing to prevent the infringements of the intellectual rights in the Internet.

To place the IAR as the information object of the intellectual property on the Internet infosphere the rightholder (author) has to provide the connection of his computer with the local network of the Internet service provider (a juridical entity or a sole proprietor), which provides services connected with the access to the Internet Global Telematics Network. At that, the information legal relationships [2] between the Internet service provider and the rightholder (author) concerning the placement and distribution of the information object, submission and payment for the provider's services are regulated by corresponding civil law agreement. The provider renders on the basis of the agreement and authorization document issued. to it by authorized state body, the services on access, protection, submission and distribution of the information about the IAR as the object of intellectual rights in the network, by establishing the information and legal regime stipulated in the agreement (legal regime of the information object of intellectual property), which foresees the authorized by the rightholder option of access (open, paid, upon royalty payment, etc.) to the IAR and legal duplication and distribution of the electronic materials both on the territory of the Russian Federation and abroad, i.e. realizing a complex of legal measures of administrative protection, as well as additional measures of technical protection. The additional organizational and legal measures of protection may be the mechanisms of international, regional and civil information cooperation oriented. at the development of the rules of professional network ethics, as well as at the resolving of jurisdiction problem in the network, of applicable law, etc.

There are different methods of revealing of infringers with the use of the system of identification of computers connected to the Internet, including the system of IP-addresses and the Domain Name System. The identification of the infringer is possible in the way of detection of the IP-address of the computer from which the illegal actions have been taken (putting on its owner the burden of proof of the fact of improper use of the computer by third person), and by applying to the administrators of the domains of three different levels of hierarchy. I n case of obstacles on the way of collection of the data on the infringer from the side of the domain

administrators, the plaintiff may bring an action against the administrator of the domain of the website where the information prejudicing the right and legal interests of other persons is placed. According to the "Regulations and tariffs for the services on registration of the second-level domains in .RU zone" (as in force since April 1. 2001), the "Rules of domain name registration in .RU zone" (since October 1. 2009), the "Rules of domain name registration in .РФ zone" (since November 11. 2010) all liability for the whole domain address space (tor conflict situations, domain use for illegal purpose, etc.) is borne, in the first place, by the domain administrator. Consequently, the domain administrator is the person who is formally liable for the infringement of intellectual rights in the Internet, its participation in the court proceedings is obligatory.

It is possible to identify the infringer on the basis of the data of *whois*-service – being the register of the registrar of the domain names in the Russian Internet segment (*www.nic.ru*) – by determining the name of the administrator of the second-level domain being the address of the corresponding website, the name and the location of its Internet service provider, etc. The evidence of guilt of the authorized persons is the *Log*-files containing the information on what authorized person, what time and how has per-formed an action with the website files on the server. It's possible to identify the person who bears responsibility for all actions executed by him or in his name by the manner of authorization.

The pretrial proceeding of providing electronic evidence represents the bringing the matter before the notary or court. At present, in order to give more evidential force to the printed pages from the Internet websites, it is used the certification of such evidence by notary, who himself logs to the respondent's Internet-server, registers as a user and compares the data contained there with the submitted data.

Upon revealing the infringer and provision of the electronic evidence, the owner of the intellectual rights may apply to the infringer with a request (according to Art. 1301 of CC RF) to eliminate the conditions, which infringe his right and/or to reimburse the losses (to pay compensation). The letter of claim establishing the term for voluntary elimination of infringement of intellectual rights (copyrights, etc) and/or payment of compensation, may be sent via e-mail. In case the infringer doesn't eliminate the infringement of the intellectual rights (copyrights, etc) within the established term, the rightholder (author) may bring an action before the court. The applicant may indicate as claims: declaration of rights, restriction of actions, recovery of damages and compensation. In particular, the requirements to the statement of claim are regulated in detail by the provisions of the Code of Arbitration Procedure of RF and of the Code of Civil Procedure of RF.

The judicial protection of intellectual rights – is the taking substantive measures of compulsory character through which the restoration (recognition) of infringed (objected) rights and the infringer treatment are executed.

The court decision which came into legal effect is published in the Internet infosphere and is obligatory for fulfillment by the persons to whom it is addressed. The decision is executed, excluding the cases of immediate execution, in the order fixed by legislative acts regulating the matters of execution proceedings. At that, the direct obligation of the provider is to cancel (delete, block) the access to the object recognized by the law as illegal, as after reception of the court decision the provider gets informed on illegality of such information object.

The analysis of the particulars and possibilities of improvement and application of the known technological and legal methods and corresponding organizational and legal provision of intellectual rights (copyrights, etc.) on the IAR protection in the infosphere of the Internet Global Telematic Network, made it possible to formulate the following expedient suggestions to provide the efficiency of the complex protection to be implemented at the state level:

- to provide general harmonization of the national legislations and elaboration of a sole

international approach to the problems arising in the course of use of the IAR in form of information objects of intellectual property in the infosphere of the Internet network, which may ensure a definite level of protection of intellectual rights on the IAR;

- to legislatively fix the legal status of the information object of intellectual property. placed on and distributed in the infosphere of the Internet;

- to impart evidence force to the multi-aspect electronic digital information (information objects, arrays, records, etc.). placed on and distributed in the Internet to meet the requirements of the legislation to electronic documents:

- to introduce into the evidence model of the legal proceedings special juridical mechanisms which provide equality of electronic and written evidence, i.e. to impart autographic status to EDS or QES (Qualified electronic Signature) [3];

- to widen the subject field for objective side of information infringements and crimes in the Code of Administrative Violations of RF, in the Criminal Code of RF. and in the Code of Criminal Procedure of RF, correspondingly;

- to supplement the existing procedural legislation with the regulations which reflect the modem state of electronic technologies and the Internet, establishing, in particular, the limits of evidence permissibility obtained by the means of electronic technologies (tor example, print-outs of web-pages, etc.).

- to fix legislatively the rights and obligations of the persons being the subjects of information exchange in the network (rightholders. Internet service providers, website administrators, owners of Internet-cafe, etc), concerning claims and demands, liability, participation in court proceedings, investigative actions undertaken by the law enforcement bodies, which supposes the introduction of corresponding changes into the Code of Civil procedure of RF, into the Code of arbitration procedure of RF, into the Code of Criminal Procedure of RF and into the Federal Law «On operational activities».

It seems expedient to work out within the scope of a special research, a scientifically grounded methodology of efficient intellectual right (copyrights, etc.) infringement proof in the Internet infosphere which will base on such fundamental principles as, the concept of justice of court proceedings within reasonable terms, principle of legality consolidation and prevention of infringements of intellectual rights in the Internet infosphere, as well as on scientifically grounded criteria of the process of proof in courts: which takes into account the requirements of the Russian and international legislation, practical experience of consideration by the Russian and foreign (Austria, Germany, USA, etc.) courts of the disputes arising in case of infringement of intellectual rights in the Internet infosphere, the particulars of collection, submitting and consideration by courts of electronic documents, as well as possibility of extrajudicial, for example through mediation, settlement of such disputes.

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LABORATORY DIAGNOSIS OF INFORMATION BUSINESS SYSTEMS

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The purpose of the article is a synthesis of theoretical and practical approaches to create and use specialized organizational and technical complexes intended for diagnostics of information business systems of enterprises. Diagnosis is based on the innovative technology of information support for the activities of corporations, enterprises, etc. Examines organizational, technological and technical aspects.

Keywords: business, information, system, problems, diagnostics.

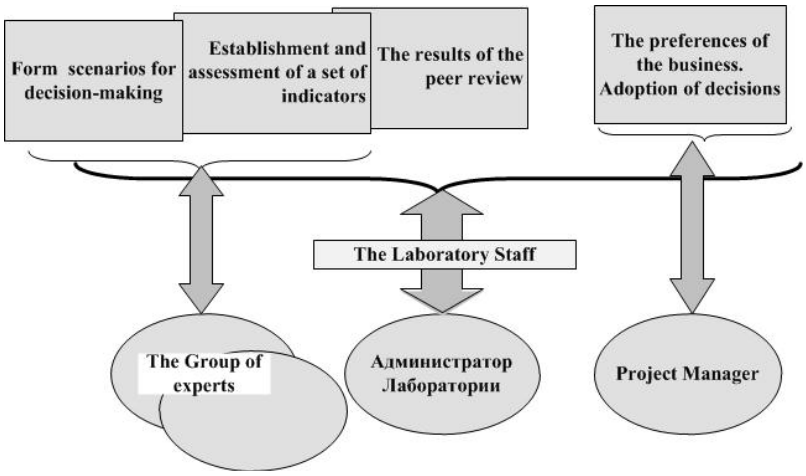
Introduction. Often corporations as customers and developers of information business systems, in conjunction with the providers of it platforms face with problems in the design, development, implementation and operation of the systems. These problems are due to the complexity of systems, lack of development of the system and analytical issues in project management and, sometimes, lack of qualified personnel who operate the system. As a rule, these difficulties are being overcome in the ordinary management and organizational practices. Therefore, a major system integrator in conjunction with the customer is faced with the need to find additional solutions, techniques and ways to improve information support of business. One of these solutions is the creation and intended use specialized organizational and technical complexes – Laboratory for the diagnosis of information business systems (hereinafter, Laboratory). The main destination of the Laboratory is to identify existing and hidden, which clearly does not appear, problems in the information support of business. The causes of these problems are hardware failures, software errors, errors that allowed the business entities in the use of information systems and staff errors in operating systems. The article deals with the organizational, technological and technical aspects of the establishment and operation of Laboratories.

Organizational aspects. The Laboratory is a group of employees with the necessary tools to perform the following processes:

- the processes the search, collection, storage and processing of Information about the problems;
- the processes the developing scenarios for decision-making to improve the efficiency of information business systems;
- the processes of providing and disseminating Information about the problems that are discovered and about decision-making scenarios to increase the efficiency of informational support of business.

The Laboratory Staff are a queuing organizational structure to carry out the functions of the above processes on the basis of apportionment of responsibility, authority and interrelationships, approved in the relevant regulations. Queue is formed due to the fact that the Laboratory Staff must collect and process information about a vast number of objects (thousands, tens of thousands, hundreds of thousands).

The topology of the queueing systems adequately investigated [1]. The main result of this study is a qualitative understanding of relationship between the quality of the organizational structure and length of the queue for executing functions of the above processes. Assertion, as set forth in this study that the higher qualifications of employees, the higher the productivity of the entire organizational structure, is important for Laboratory of the diagnosis of information business systems. Figure 1 shows the main roles of the Laboratory Staff and functions related to the assessment of the effectiveness of informational support of business



Puc. 1 Basic functions of Laboratory Staff

Technological aspects. The Laboratory performs the tasks set by the owner of the project, based on the Technology of information support for the activities of the enterprise [2].

Technology highlights:

1. The development, maintenance and provision of information about the normalized indicators of informational support of business:

- the data about the normalized indicators for the objects, that have an impact on the status of the information business systems (IBS);
- the data about the normalized statuses of the objects that have an impact on the status of IBS;
- the data about the normalized statuses of IBS that function in the divisions of the enterprise;
- the data about the normalized statuses of each IBS (taking into account all divisions of the company);
- the data about the normalized statuses of informational support of business of the enterprise (taking into account all IBS).

2. The development, maintenance and provision of operational information (actual information for the current interval time) about the actual indicators of informational support of business:

- the data about the actual indicators for the objects, that have an impact on the status IBS;
- the data about the absolute value of deviation of actual indicators for the objects from the normalized indicators for the objects;
- the data about the actual statuses of the objects that have an impact on the status of IBS;
- the data about the actual statuses of IBS that function in the divisions of the enterprise;
- the data about the actual statuses of each IBS (taking into account all divisions of the company);
- the data about the actual statuses of informational support of business of the enterprise (taking into account all IBS).

3. The development, maintenance and provision of information about the effectiveness of informational support of business:

- the data about the actual indicators the IBS's effectiveness in the divisions of the enterprise;

- the data about the actual indicators of the effectiveness of each IBS (taking into account all divisions of the company);
- the data about the actual indicators of the effectiveness of informational support of business of the enterprise (taking into account all IBS).

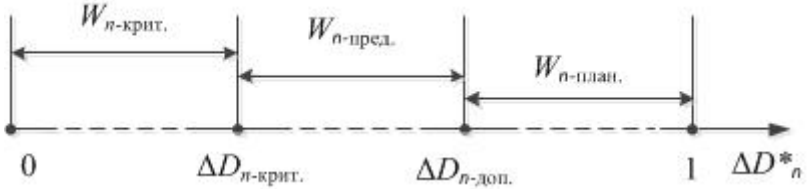
4. The development, maintenance and provision of information about the scenarios for decision-making to improve the efficiency of information business systems to the customer:

- the data about the critical, the warning and the planning scenarios designed to support decision-making, accordingly, in order to eliminate the existing problem, to prevent manifestation of latent problems and to increase the effectiveness of informational support of business as a whole;
- the data about the critical, the warning and the planning scenarios designed to support decision-making, accordingly, in order to eliminate the existing problem, to prevent manifestation of latent problems and to increase the effectiveness of each IBS (taking into account all divisions of the company);
- the data about the critical, the warning and the planning scenarios designed to support decision-making, accordingly, in order to eliminate the existing problem, to prevent manifestation of latent problems and to increase the IBS's effectiveness in the divisions of the enterprise.

As an example, figure 2 shows the selection rule the scenarios for decision-making on support for the n-th (n=1, 2, ….) IBS:

- a critical scenario $W_{n\text{-крит.}}$ select if the actual indicator ΔD_n* of the effectiveness is in the range $0 \div \Delta D_{n\text{-crit.}}$;
- a warning scenario $W_{n\text{-пред.}}$ select if the actual indicator ΔD_n* of the effectiveness is in the range $\Delta D_{n\text{-крит.}} \div \Delta D_{n\text{-доп.}}$;
- a planning scenario $W_{n\text{-пред.}}$ select if the actual indicator ΔD_n* of the effectiveness is in the range $\Delta D_{n\text{-доп.}} \div 1$,

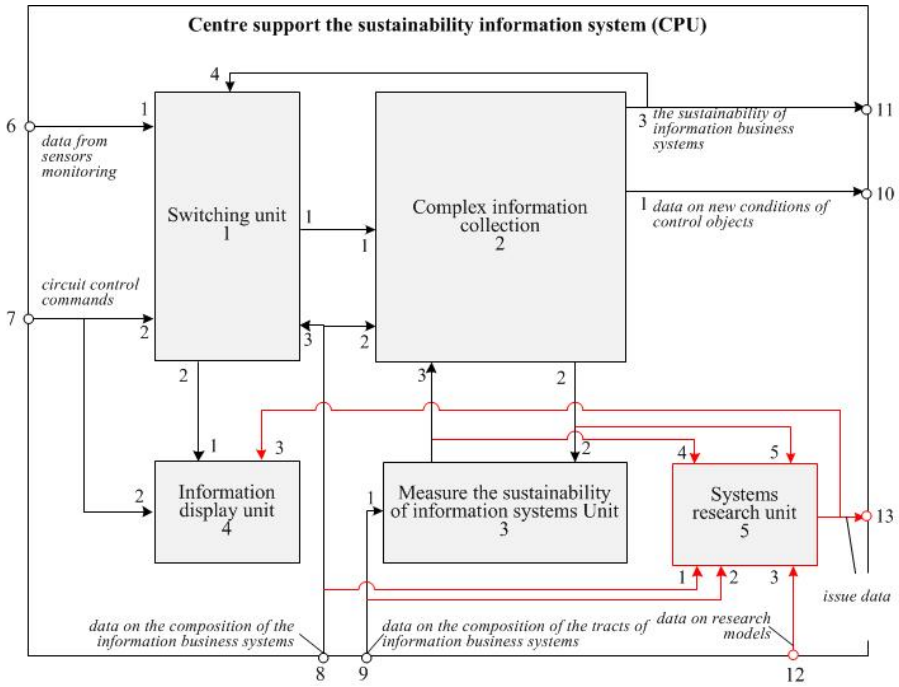
where $\Delta D_{n\text{-крит.}}$ и $\Delta D_{n\text{-доп.}}$ – accordingly, a critical and valid performance indicators.



Puc. 2 Chart for selecting the script action

Technical aspects. The Lab Toolkit for implementing the above technologies of information support for the activities of the enterprise, equipped with hardware and software in accordance with the technical solutions developed for maintaining the sustainability of information business systems [3, 4]. Figure 3 shows a block diagram of the Center for sustainability [4].

Let's look at an example that illustrates the provision of data on indicators of sustainability of all tracts one IBS Enterprise. A collection of information about tracts defines sustainability of all IBS Enterprise. All status codes the objects (assets) are divided into two groups: the operational codes and the inefficient codes for any of the indicators of that control. In General, illustrated in example operations are performed on each tract for each IBS Enterprise, each, of the means to ensure their functioning, whose condition is controlled by sensors.



Puc. 3 Block diagram of the Center for sustainability

Source *data*:

- in IBS there are tracts with the codes T_{11}, T_{21}, T_{31}; ten means support IBS, which is controlled by sensors, codes of means are S_1, S_2, ..., S_{10};
- the tract T_{11} includes codes of means – S_1, S_2, S_5, S_8;
- the tract T_{21} includes codes of means – S_3, S_5, S_7, S_9;
- the tract T_{31} includes codes of means – S_4, S_6, S_7, S_{10};
- statistical reporting period – T (e.g., monthly, quarterly, etc.);
- data on indicators of IBS from complex 2;
- data about models of research stored in a complex 5.

Операция 1. Build a matrix of actual status of means and of tracts of IBS is performed according to table 1.

Табл. 1. A matrix of actual status of means and of tracts of IBS

Codes of means and codes of tracts	Health code means (yes*, no**)	Code of sustainability of tract (yes*, no**)
Tract T_{11}		yes
Means S_1	yes	
Means S_2	yes	
Means S_5	yes	
Means S_8	yes	
Tract T_{21}		no
Means S_3	yes	
Means S_5	yes	
Means S_7	no	
Means S_9	yes	
Tract T_{31}		no
Means S_4	yes	
Means S_6	yes	
Means S_7		no
Means S_{10}	yes	

* Tract (means) works consistently.

** Tract (means) is unstable.

An example of tract of IBS is given in Figure 4.

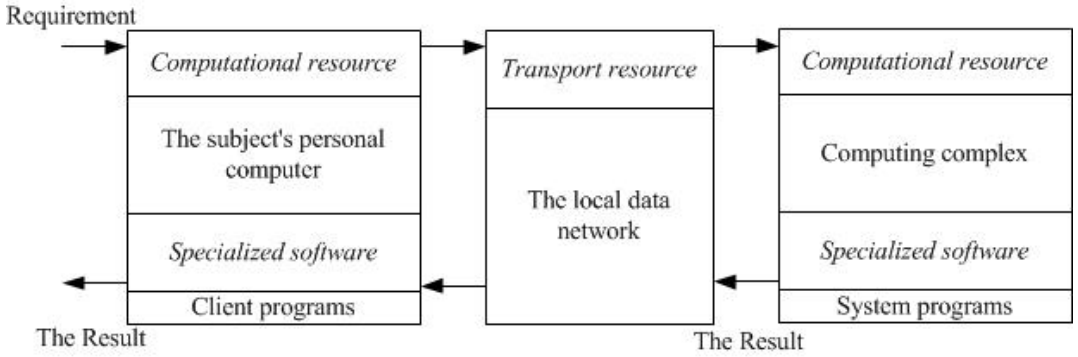


Fig. 4 Tract of Information business systems (example of)

Operation 2. Communicate information about the matrix (table 1) with the release of 3 in the fourth entry of 5.

Operation 3. Make a comparison this matrix with the matrix, which describes the previous states. This operation is performed at 3 when the tract from the volatility in state of sustainability. The form and saves the following data:

$t_{i\text{-}1}$** – Data on the start time of the last interval, the volatility of the tract in the current period T_i, i=1, 2, … ;

t_i* –Data on the end time of the last interval, the volatility of the tract in the current period T_i, i=1, 2, … ;

$\Delta t_i = t_i$*- $t_{i\text{-}1}$** – Data on the duration of the last interval, the volatility of the tract in the current period T_i, i=1, 2, … .

Operation 4. Form data (in 3) on the sustainability of tract of IBS after receiving data from complex 2. Determine the coefficient U_i of the sustainability of this tract U_i:

$$U_i = 1 - \sum_{i=1}^{N_i[t_i^*-T_i;t_i^*]} \Delta t_i \,/\, T_i \,, \qquad (1)$$

where

U_i – Data on the coefficient of the sustainability of this tract in the current period T_i, i=1, 2, …;

t_i*-T_i – Data on the start time of the current period $T_i = T$, i=1, 2, … ; if the data have a negative value then this data is assigned the value data to the time of the beginning of operation IBS (the case, at which time the IBS from the date of putting into operation less than T);

N_i [t_i*-T_i; t_i*] – the number of intervals volatility tract in the current period T_i ;

t_i*-T_i – the beginning of the period;

t_i* – end period.

Operation 4. Data on stability of IBS are transferred from the 3 to third entrance 2.

Complex systems research 5 after receiving data from the 3 stores this data and performs actions as defined by the problems in IBS.

The following are techniques that are used in the diagnosis of information business systems.

Method of determining the technical fault means:

1. After receiving data on the current state of the means and tracts of IBS, for each means listed in the matrix is determined by the number $n(S)$ to the unhealthy state of the means S with the data of previous matrices;

2. If $n(S)$ is equal to the specified number $n_{зад.}(S)$, are determined by the number $n(S_k)$ the same indicators for the means, which are attributable to each of the $n_{зад.}(S)$ cases, unhealthy, where k is the number of indicators;

3. If $n(S_i)$ equal to the specified number of $n_{зад.}(S_i)$ and the amount equal to the specified number of $n_{зад.}(S_k)$, then complex systems research 5 will generate information on the existence of problems in IBS, resulting from technical means S. These data include data blocks:

- data blocks about means ID;
- data blocks about IBS and about tracts, which using this means.

4. This data is passed to the exit 13 and on, for example, Enterprise Support Center – to solve the problem, or another service, in accordance with the regulations, and the third entry of 4 to display information to businesses and employees in the Lab.

Method of determining errors in the program. This method is used in the general case is similar to p. 1, but the number of failures (stop) the software shall be determined for each instance of the same manufacturer and of the same grade, regardless of their placement in the tracts and in information systems.

Physical interpretation of the results of the application of the above methods is that it automatically detected the problem that was causing incidents on previous $n_{зад.}(S)$-1 occasions to no means S. Recovery funds S in these cases were circuitous ways that did not address the root cause of the failure – a problem. When the problem becomes known, this allows you to quickly start work on her decision and troubleshooting technical features or bugs in the program.

Other models and methods of laboratory research information business systems of enterprise- customer project to carry out these research identify hidden problems that stem from:

- Business actors and staff errors, who runs IBS;
- harmful effects of hardware and software;
- IBS design developer errors.

Conclusion. About economic benefits. Discussed in this article, the decision to use the Laboratory diagnosis of IBS economically justified for the following projects:

1. The stationary Laboratory diagnosis of IBS Enterprise for Corporation – subject to the availability of the enterprise management information system developed business support:

- the existence of regulated processes of ITSM;
- the availability of existing complexes of automation of these processes;
- highly skilled IT staff.

In this case, the enterprise-a system integrator, owning a Laboratory diagnosis of IBS, produces and creates such a laboratory on the firm-customer, including taking into account the experience.

2. Remote use of Laboratory diagnosis of IBS within projects on support of IBS enterprise by Enterprise-System Integrator.

This case is important for medium-sized enterprises, which have developed business support information management system, but that does not allow domestic investment in the establishment and operation of Laboratories. In this case, to allow remote research tool in the Laboratory of the Enterprise-System Integrator using access technology of IBS enterprise, this can be found in the article [5].

3. For projects that open up the company to carry out ad hoc or cyclical diagnostic studies.

Such projects are typical:

- for small businesses that are actively using information technology;
- for businesses that are expanding business and before establishing its own Laboratory, require an audit of the trust in the information business support.

For the occasion of Lab Tools System Integrator use mobile information support centres, which are based on the technical solutions [3, 4].

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PRESENT STAGE OF E-GOVERNMENT DEVELOPMENT IN RUSSIAN REGIONS: PROBLEMS AND PROSPECTS

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This paper analyzes the innovation aspects of sharing interagency information in order to provide electronic public services in Russia. Electronic Government in Russia became a strategic component in the governance process. Based on official policy documents and practical case studies of e-government projects at the federal and regional levels of government, the authors formulate substantial barriers and control features development of e-government in Russia.

Keywords: information society, e-government, public services provision, e-services portal, Interagency Electronic Exchange System (IEES).

Information society, innovation management and modern management techniques in the world are seen as the main source of progress and civilized development , especially in times of problems and crises. Information society, creating new values, political and social priorities, new forms of civil society participation in government, has enormous economic potential. With the introduction of information technologies in the public services reduces the time required to collect documents, increasing the quality of services provided.

System of government in Russia is also in line with global trends, the rapid progress of the information society, based its development on the widespread adoption of e-government elements (hereinafter - EA), as an innovative way to «interaction on the active use of ICT to improve the efficiency of public services» [1]. In this large-scale computerization of government agencies, according to a statement VV Putin is:

- serious resource for strengthening the national economy, increasing investment attractiveness;
- important condition for effective social modernization , qualitative changes in the health, education, social protection system;
- a simpler and more transparent communication of citizens with the government;

- real and very effective anti-corruption measure. [2]

Thus information and communication technology today determine the development of civilization and the level of competitiveness of individual economies, so the government attach great importance to their development and success indicator of this work consider the position of his country in various international rankings.

Thus, the most famous is the rating of readiness for e-government (UN e-Government Readiness Index), published by the UN every two years , in 2012 Russia took 27th place out of 190 by jumping 32 positions. In the subset of countries with a population of over 100 million people. Russia is on the 3rd place, behind only the U.S. and Japan, far ahead of its partners in the BRIC - Brazil, India and China.

Positive dynamics of the index in this period was achieved thanks to the company's general introduction and promotion of e-government services at the federal level and the launch of a single portal of public services (http://www.gosuslugi.ru).

Successful entry into operation of the federal segment VC showed that this project in Russia there are prospects for development and he is in demand from citizens. Thus, in its report submitted 15.11.2013 in Washington (USA) in our «Day of Russian ICT», Deputy Minister of Communications and Mass Communications of the Russian Federation Alexey Kozyrev said that «to date, work has already resulted in savings of citizens of our country more than 100 million hours. Each transaction in the e-government means that its user did not go anywhere with a paper document» [3].

Recognizing the importance of this work can not be overlooked that the integrated assessment of the country's readiness for e-government is composed of several indicators characterizing the level of infrastructure development and e-government services, as well as the level of readiness of citizens to use e-government services.

In this regard, it is necessary to give a positive evaluation timely actions of the Russian government to revise its policy approach to information technology. So, at the initial stage, the main efforts to develop e-government were applied in the direction of maximum accessibility of e-government services, as well as dominance and greater demand segment of interagency cooperation («G2G») e-government.

At the present stage of development comes the realization that the value becomes not the introduction of technologies and development of information systems per se, but rather what benefits they bring to citizens, businesses, the whole society.

The role of the state is changing - it has become the operator of regulating access to information and services in a proactive mediator. In this context, it is important that the information and services focused on improving their understanding of the users needs and interests of citizens. Now we need to consider citizens not only as passive recipients of information, but as active partners, who need support in their interaction with the government using ICT through the dissemination of relevant government information.

Thus, the Russian Federation has made important steps towards the introduction of the concept of «state service», where one of the key problems is the transition to a « new generation of standards of public services - based not on the position of the artist, and on the position of the consumer of these services» [4].

Adoption and approval at the federal level in late 2013 and early 2014, a number of key conceptual documents suggests the beginning of a new stage in the development of e-government in Russia - phase of the complex socio-important government information systems to facilitate the interaction between citizens and the state, as well as improve the quality of public services.

A special place in the list of basic documents EP development in Russia takes concept development mechanisms of public and municipal services in electronic form [5], which defines the main objectives, principles and actions for the further development of mechanisms of public

and municipal services in electronic form for the period until 2016, as well as organizational management model in this activity.

The results of the Concept of Development of mechanisms of public and municipal services in electronic form should be to increase the availability of services for citizens and organizations, facilitation of interaction with bodies (organizations) providing services, reduction of corruption risks, improving the efficiency of budget expenditures.

The next document is the defining concept of openness of the federal bodies of executive power [6], which lays down the basic principles of openness of ministries and departments, objectives and mechanisms (tools) for their implementation, and also contains a set of strategic guidelines on transparency in governance, accountability, and accountability of power to a civilian society and the formation of an effective dialogue between authorities and citizens, public associations and the business community.

To respect the principles of openness to the federal executive bodies in this document a number of objectives , including:

- providing a clear and accessible form of complete and accurate information about the goals, objectives, plans its activities in the years 2013-2018, and during their execution;
- improving technology to provide information and explanations;
- increasing the availability of open government data, including reuse, providing free access to the Internet;
- implementation of processes and infrastructure for public online consultation with citizens and organizations;
- the formation and development of effective mechanisms for rapid response to treatment;
- improving the forms, methods and ways of working with the media , social networks and forums on the Internet.

Moving towards the creation of a centralized model of e-government, the Russian Federation is actively developing it at the federal level, forming the all-Russian Internet resources on providing information and electronic services for citizens. However, the transition to the regional and municipal level of government especially, the pace of development of e-government are reduced, suggesting that the shortcomings in government policies and the significant disparities in the level of readiness for its implementation in specific territorial entities.

Therefore, as one of the main objectives of this study is to analyze the author's problems and prospects of development of the definition of e-government processes at the regional level within the contemporary stage . As an example, the development of regional e-government in Russia selected informatization process having significant economic and human potential of the region: the Rostov region.

Rostov region occupies the 6th position in the ranking of subjects of the Russian Federation on the level of e-government, e-journal published by «GosMenedzhment» [7] , while firmly holding the first place in the Southern Federal District. In addition, the region is among the top three regions to develop a network of multipurpose centers. As for universal electronic cards, the rating of the RF subjects implementation plan for their implementation as of mid- 2013 the region is in the top ten subjects leaders.

The main research method was chosen questionnaire experts enables us to obtain an assessment of processes and formulate a basic list of the main problems , and possible ways to overcome them in the implementation of technologies and methods of e-government at the regional and municipal level. The study has developed specialized questionnaire used in the survey, 408 heads of municipalities of the Rostov region, participating in training courses on «Basics of activity of the head of the local administration on the organization of settlements

resolution of local issues», was held at the South-Russian Institute - RANEPA branch in October-November 2013.

According to the results of the expert survey, a list of barriers to implementation of the concept of e- municipality in the Rostov region in terms of their relevance. For example, the most acute and important problems of local government leaders carried:

- the lack of activity of the population, lack of demand for electronic services, low level of computer literacy among the population;
- lack of economic mechanisms and legal norms of interaction of subjects of the municipality in a single information space;
- incompatible formats and protocols for information exchange;
- low level of skills in information technology.

Results of the study support the conclusion that the path to e-government regions to overcome many obstacles, wearing as a system, a federal scale (the need to harmonize regulations of the various government agencies and a large number of IT systems) and with regional, local level (no frames, low competence users insufficient technical equipment municipalities).

In the course of the questionnaire were the main directions of development of the concept of e-municipality in the Rostov region. Among the most promising directions of experts pointed out:

- information openness of local governments included in the municipal information resources;
- enable and support projects public-private partnership in the field of information technology;
- business development and creation of territorial integrated automated information system.

High relevance and social importance of the implementation of a system of regional problems of e-government, as well as the results of the expert survey, allow a group of experts of the South Russian Institute - a branch RANEPA to start work on the development and implementation of information-analytical system «Electronic region - Rostov Region» (hereinafter - IAS ER).

Taking into account that a large number of Rostov region disparate socio- oriented information systems and overall strategy Mininformsvyaz Rostov region, aimed at creating a unified regional information infrastructure, it seems urgent to build on a regional public Internet resource that provides access to social and business-oriented services and data. The proposed resource is based on the use of a single visual shell understandable and convenient for citizens of Rostov region, belonging to different social groups.

Structure and flow of information flows IAS ER will be focused on areas: citizens of Rostov region, the business organization of the Rostov region, investors. Information will be supplied by connecting to IAS ER subsystems, whose composition can expand indefinitely.

The main structural elements of IAS ER serve the following subsystems:

- providing an interactive, open and effective dialogue between the executive authorities , citizens and businesses - «National control»;
- organization process of public and municipal services , perform the functions of the interagency electronic interaction and provide clear information on the portal about how to obtain services in the Rostov region - «Services and interagency cooperation»;
- openness budget formulation and execution for the inhabitants of the region and the particular municipality - «Open Budget»;
- combining information registers in electronic form and automate the collection , processing and presentation of data for the municipal government to increase the investment

attractiveness of the municipality and the region as a whole, as well as the preparation of regulatory reporting for transmission to the regional level - «Electronic Passport municipality».

The main objectives of the development and implementation of IAS ER are:

- creation of a single technology platform in order to create new socially significant services to citizens and organizations of the Rostov region;
- formation of socially-oriented information space, providing citizens with an opportunity to deal effectively with issues that arise within specific situations;
- increasing the loyalty of the population to electronic methods of interaction with regional authorities and local government bodies;
- improving the quality of statistical information by obtaining information from citizens and its further updating;
- increase openness and transparency of the regional government and local authorities.

IAS ER consists of 4 generalized structure elements (figure):

1. Regional Internet portal «e-Region», which is:

- semantic search engine for real-life situations;
- a single socio-oriented interface for e-services from different information systems in the region;
- a visual representation of the consolidated budget of the region as a whole and individual municipalities sectional areas, especially socially significant;
- services for people and organizations to enable submit proposals to the regional budget and / or the municipality, as well as suggestions for opportunities to save;
- renders a view of the open data supplied by state and municipal information systems in the context of subject areas;
- renders a view of the open data supplied by the commercial sector providing social services and their information representation.

2 . Regional Information Service Bus (hereinafter - RISSH).

The main purpose is to create RISSH regional information service platform, which enables integration of information flows and databases of various regional and municipal information systems for the provision of socially important electronic services and public organizations of the Rostov region, by combining into a single information space.

To RISSH basic functions should include the following:

- single authorization staff departments (ESIA and / or NRI);
- open API, to allow the integration of various subsystems within the region;
- access to regional databases and directories;
- ensuring access to public regional, municipal electronic services;
- the ability to connect with the publication of commercial services on the portal their ER.

Benefits provided by IAS ER architecture provide the ability to:

- integration of disparate information systems and databases;
- business involvement in the creation of socially important services;
- improving the process of connecting new services through a simplified registration, standardization and open API;
- unification of interfaces developed IP;
- flexible architectural growth and scalability of the system;
- orientation of the cloud.

Thus all integrable information systems retain their logical architecture and functionality thus solved the problem of independent development, but introduced common rules and requirements for connecting to a single space IAS ER.

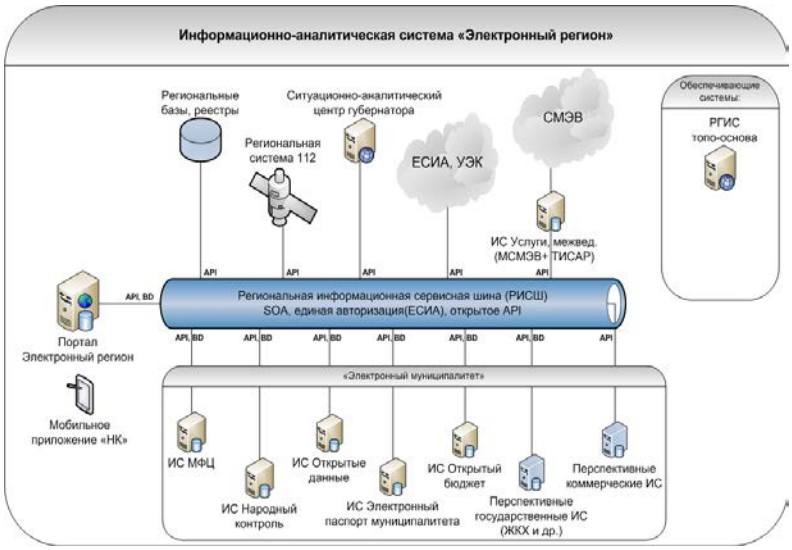

Figure. Architecture information-analytical system «Electronic region - Rostov Region»

3. Service-oriented information systems regional executive bodies and local authorities.

The element of the system is designed to implement the business logic such areas as:

- popular control;
- electronic passport municipality;
- public budget;
- open data;
- existing municipal IP;
- other plug to RISSH information systems.

In the proposed architecture, interaction , extending the functionality of IAS ER performed by connecting the (integration) of new information systems implementing the business logic and meet the necessary requirements at the time of connection.

4 . Commercial service-oriented information systems.

IP suppliers are considered socially - oriented services for people and organizations in the region, including work created within commercial organizations on state and municipal contracts.

As an example, the following services:

- payment services (banking, insurance and any other remote services sector);
- information services , such as information about the evacuation of car - parking fee (the necessary information can be reflected by a citizen in a private office) , disabling water, light and other emergency situations.

In developing IAS ER experts developers accounted for the possibility of its further development and modernization in the following areas:

- enhanced functionality through additional development and / or implementation of new modules and subsystems;
- expanding the list of services and electronic services for the subsystem «Services and interagency cooperation»;
- increase in the number of users in a timely modernization of computing power logistics system;
- communication with federal IP through the use of web services;
- the principle of development (openness). The system will be designed with the possibility of replenishment and renewal functions without compromising the integrity of;

- the principle of compatibility. Will be implemented on the basis of information interfaces of web services through which the system can communicate with other systems in accordance with established rules;

- the principle of standardization (unification). When designing the model will be applied , uniform and standardized elements , design solutions , software packages , systems and components ;

- the principle of development (modifiability) will be provided the opportunity to develop, extend and integrate with other systems;

- principle authorized access to information. IAS ER provides authorized access to information and has the functions of administration.

The above example of e-government in the Rostov region demonstrates that the process of informatization further effective governance in the Russian Federation is largely dependent on the timeliness of management, not just technological solutions at the level of the federal government. Developing common to all regions of Russia recommendations and standards implementation of e-government, a clear prioritization of projects within the EP adopted the concepts of development, closely linked to the size of their financing to tangible results, are necessary conditions for the qualitative improvement of the socio-economic situation in the country.

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STATISTICAL ANALYSIS OF REGIONAL IDI INDEX IN THE COMMONWEALTH OF INDEPENDENT STATES (CIS)

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Formation and development of information society in the Russian Federation presupposes a rise in living standards of population, progressive development of social-

economic and cultural spheres of society, state government system evolution on the basis of the use of modern information and communication technologies.

Keywords: ICT Development Index (IDI), IDI access index, IDI use index, IDI skills index, Commonwealth of Independent States (CIS).

In international practice of studying information and telecommunication technologies development level and their regional comparative analysis an Information Technologies Development Index (IDI) is used as an indicator and a monitoring tool characterizing the general progress that countries have reached in the process of information society creation. The main aims of IDI computation are [5]:

- To measure the ICT level and changes in the ICT development dynamics both within countries and in comparison with other countries;
- To determine the progress rate of ICT development both in developed and developing countries;
- To determine a digital divide among countries with different levels of ICT development.

IDI comprises such ICT indices, which, when properly used, are critical for a country heading for information society development:

1. ICT readiness (reflecting the level of networked infrastructure and access to ICTs);
2. ICT intensity (reflecting the level of use of ICTs in the society);
3. ICT impact (reflecting the result/outcome of efficient and effective ICT use).

The Commonwealth of Independent States (CIS) regional ranking is headed by the Russian Federation, with an IDI of 6.19, just ahead of Belarus (6.11) and Kazakhstan (5.74). Belarus is among the most dynamic countries of the IDI, and is closing the gap with respect to the Russian Federation. Uzbekistan ranks last with an IDI of 3.12, which is by far the lowest IDI value in the region (Table 1). While all CIS countries – with the exception of Uzbekistan – have an IDI above the world average, all the countries in the region remain below the developed-country average (see Chart 1). The CIS region is the region showing the strongest improvement in regional IDI value from 2011 to 2012, with the regional IDI climbing from 4.65 in 2011 to 4.95 in 2012. This is the second highest regional IDI after the Europe region (6.73). All CIS countries, with the exception of Uzbekistan, display above-average increases in IDI value. In particular, major improvements can be seen in the access sub-index, with a number of countries, including Belarus, Georgia, Kazakhstan, Moldova and Ukraine, increasing their value by at least twice the global average.

Table 1 – IDI index in Commonwealth of Independent States (CIS) [4]

Economy	Region rank 2012	Global rank 2012	IDI 2012	Global rank 2011	IDI 2011	Global rank change 2011-2012	IDI change 2011-2012
Russian Federation	1	40	6,19	38	5,94	-2	0,25
Belarus	2	41	6,11	46	5,57	5	0,54
Kazakhstan	3	48	5,74	49	5,41	1	0,33
Azerbaijan	4	61	5,01	60	4,62	-1	0,39
Moldova	5	65	4,74	67	4,46	2	0,28
Ukraine	6	68	4,64	69	4,38	1	0,26

Georgia	7	71	4,59	73	4,24	2	0,35
Armenia	8	74	4,45	75	4,18	1	0,27
Uzbekistan	9	104	3,12	104	3,02	0	0,1

The following countries from the examined pool show the highest rates of ICT development: Belarus – 9.7 % growth in 2012 in comparison to 2011 (Global rank 41), Kazakhstan – 6.1% growth (an IDI of 5.74) and Ukraine – 5.9% (an IDI of 4.64). Russia went down to rank 40 among 157 countries under examination with an IDI of 6.19 (in 2011 Russia ranked 38 with the index of 5.94, while the leader country had an IDI of 8.51). However, Russia shows a high rate of ICT index growth in 2012 in comparison to 2011 – a 4.2% increase.

A comparison of IDI indices of 2011 and 2012 shows that the rate of IDI value growth for such countries as Belarus, Kazakhstan and Ukraine has outnumbered the general average growth rate for developing countries of 5.8 %. While Russia is approaching a level of saturation, in particular, in the sphere of mobile phone contracts and access contracts, households of Belarus, Kazakhstan and Ukraine, where the penetration levels remain considerably lower, are still of great potential for growth.

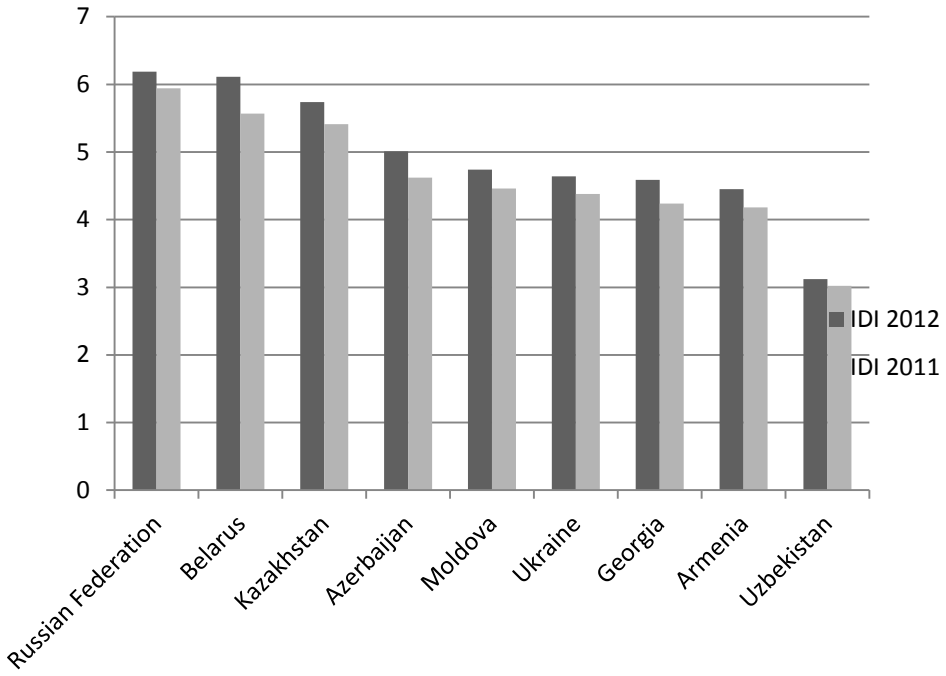

Chart 1 – IDI index values in the Commonwealth of Independent States (CIS)

We should note that while the process of information technologies saturation is observed in dynamics of developed countries, thus leading to the decaying nature of cumulative index growth rate, developing countries are showing the opposite tendency. At the same time there remain huge differences in access to ICTs, ICT use and skills in the sphere of ICT. So, Europe is not only a region featuring the highest average IDI value of 6.73, but also the most homogeneous region, in which in 2011–2012 both the value range and the variability coefficient continued to decrease, pointing to regional digital divide reduction. A contrary trend is typical for the CIS countries, Russia, Belarus, Kazakhstan and Ukraine, in particular, as differences in ICT development have increased in 2011–2012.

So, in 2012 the range of IDI values in developing countries was of 7.58 points with (theoretically) possible range of values from 0 to 10. In the year of 2012, the IDI in Russia was

80% higher, in Belarus - 78% higher, in Kazakhstan - 67% higher and in Ukraine - 35% higher than the average value of developing countries of 3.44 points. Herewith, Uzbekistan is the only country of the whole CIS pool with IDI index more than 9% lower than the average level of developing countries. A standard deviation of the index was 1.75 points with the variability coefficient of 50.79%, which is a highly essential variability degree.

According to the computational methodology, IDI index is a cumulative parameter comprising 11 basic indicators, which at the end make up a single control value, measured with a scale from 0 to 10. The pool of these parameters is divided into three groups. As a result, three aggregated sub-indices are simulated: ICT access sub-index (level of readiness), ICT use sub-index, ICT skills sub-index (table 2).

IDI access sub-index measures infrastructure and readiness of communication technologies, which is the main requirement for using and benefiting from ICT. From 2011 to 2012 cellular mobile communication growth rates in developing countries amounted in average to 8% per year (in comparison to 4% in developed countries). Major advances are also being made in terms of increasing international Internet bandwidth, and a number of new fibre-optic submarine cables are providing countries with more capacity. According to Telegeography, "International bandwidth demand growth has been robust on all five of the world's major submarine cable routes, but has been particularly rapid on key routes to emerging markets in Asia, Africa, the Middle East and Latin America" [1].

Table 2 – ICT Development Index: indicators and reference values [4, p. 21]

ICT Development Index	*Indicators*	*Reference value*
I. *IDI access sub-index*	- Fixed-telephone subscriptions per 100 inhabitants	60
	- Mobile-cellular telephone subscriptions per 100 inhabitants	190
	- International Internet bandwidth (bit/s) per Internet user (This corresponds to a log value of 5,79, which was used in the normalization step.)	621,834
	- Percentage of households with a computer	100
	- Percentage of households with Internet access	100
II. *IDI use sub-index*	- Percentage of individuals using the Internet	100
	- Fixed (wired)-broadband subscriptions per 100 inhab.itants	60
	- Wireless-broadband subscriptions per 100 inhabitants	100
III. *IDI skills sub-index*	- Adult literacy rate	100
	- Secondary gross enrolment ratio	100
	- Tertiary gross enrolment ratio	100

The access sub-index ranking of the CIS countries shows, in general, positive dynamics. As of the end of 2012, the largest positive changes in the ICT access sub-index are in Kazakhstan (6.6) and the Republic of Belarus (6.41), both countries climbing 6 ranks up and taking positions 41 and 47 in the global rank with absolute index growth of 0.46 and 0.4 points respectively. The Russian Federation has improved its positions, even though not that significantly, climbing 2 positions up the global rank and placed 37 in 2012 with the index of 6.73 points and the year index growth of 3.1%. We should also point out that the access index for Russia is 2% higher than the respective value of Kazakhstan, 5% higher than that of the Republic of Belarus and 16% higher than the level of Moldova (Table 3).

Table – 3 IDI access sub-index index in Commonwealth of Independent States (CIS) 2011 and 2012 [4].

Economy	Region rank 2012	Global rank 2012	IDI 2012	Global rank 2011	IDI 2011	Global rank change 2011-2012	IDI change 2011-2012
Russian Federation	1	37	6,73	39	6,53	2	0,2
Belarus	3	47	6,41	53	6,01	6	0,4
Kazakhstan	2	41	6,6	47	6,14	6	0,46
Azerbaijan	6	70	5,17	72	4,84	2	0,33
Moldova	4	59	5,81	60	5,45	1	0,36
Ukraine	5	68	5,27	68	4,88	0	0,39
Georgia	7	73	5,06	74	4,65	1	0,41
Armenia	8	79	4,52	79	4,23	0	0,29
Uzbekistan	9	127	2,38	118	2,44	-9	-0,06

The rest of the CIS countries have ICT access index below the average (5.33) of the total pool under examination. So, despite both increase of the access index itself by 0.33 points during a year, and consolidation of the position in the global rank from position 72 in 2011 to position 70 in 2012, the access index of Azerbaijan is of quite a low value, which is 30% below the RF level. The closest to each other both in value of sub-index itself, and also in global rank positions are Ukraine, Georgia and Armenia, which have made basically no improvement during the year. So, in 2012 Ukraine and Armenia keep on their positions 68 and 79 in the countries ranking with the index values of 5.27 and 4.52 respectively, which make 90.7% and 89.3% from the value for Russia. Uzbekistan showed the worst results going 9 positions down from rank 118 in 2011 to rank 127 in 2012 (the value of index is 52.7% of the level of Russia).

An analysis of ICT development in the Russian Federation shows that despite the close connection between ICT development level and income level, government is able to boost growth and implementation of ICT by means of creating, among the others, an open regulatory base, which favors competition and leads to reduction of prices, and also by means of encouraging of private sector investments. Programs proposed by the state have facilitated broadening of ICT access and ICT use. A significant growth of the number of contracts for wireless broadband and fixed line broadband connection enables the countries under examination to increase household access to ICT and ICT use, and also to attract more people to work in the Net.

ICT use index is a parameter featuring the intensity of use of information and communication technologies. According to the estimates of specialists, by the end of 2013 the number of Internet users worldwide has increased by 40% and is 2.7 billion people. In developed countries the level of Internet penetration is more than 80% (in Iceland, Norway, Denmark exceeding even 90%).

According to data of the International Telecommunication Union, the position of Russia in the global ranking of ICT use index has not changed from 2011, and it corresponded to position 42 with the value of 4.34 points in 2012. However, it is the Russian Federation, which tops the CIS countries rating for this indicator. Herewith, we should note a considerable improvement of the position of the Republic of Belarus, which went 7 positions up and took rank 45 in the list of countries with the value of 4.13, being only 5% lower the Russian index

(table 4). As of the end of 2012, the absolute growth of sub-index in this country was 2.4 points. The position of the Republic of Kazakhstan related to the index value has improved somewhat, even though in the countries rating it actually went down from rank 47 to rank 31 with the value of 3.71 points in 2012, which makes 85.5% of the level of Russia. Azerbaijan, with the value of 3.72 points in 2012 corresponding to 85.7% of the Russia's level, is the fourth country with the sub-index value higher than the average level of CIS countries pool. Azerbaijan has improved its positions and moved in 2012 from rank 53 to rank 50 in the world's ICT use rating.

Table – 4 IDI use sub-index index in Commonwealth of Independent States (CIS) 2011 and 2012 [4].

Economy	Region rank 2012	Global rank 2012	IDI 2012	Global rank 2011	IDI 2011	Global rank change 2011-2012	IDI change 2011-2012
Russian Federation	1	42	4,34	42	3,91	0	0,43
Belarus	2	45	4,13	52	3,17	+7	0,96
Kazakhstan	4	51	3,71	47	3,37	-4	0,34
Azerbaijan	3	50	3,72	53	3,07	+3	0,65
Moldova	7	80	2,27	80	1,94	0	0,33
Ukraine	9	92	1,76	91	1,49	-1	0,27
Georgia	5	64	2,82	64	2,35	0	0,47
Armenia	6	69	2,6	70	2,21	+1	0,39
Uzbekistan	8	88	1,95	86	1,65	-2	0,3

Such countries as Moldova, Ukraine, Georgia, Armenia and Uzbekistan round out the ICT use sub-index rating of CIS countries, as the values they got are below the average of CIS countries pool. As of the end of 2012, Ukraine was ranking 92 in the global rating with the absolute index change of +0.27 points (1.76). The Republic of Moldova is also of applied interest as it has improved its rating of ICT use by 17.01%, which has placed it at the rank 80 in the world rating. Nevertheless, the Moldova's absolute index value (2.27 points) did not exceed the average level of CIS countries index of 3.03 points. Poor results of ICT use level are also observed in the Republic of Uzbekistan, which has gone 2 positions down and is ranking only 88 in the world rating of countries, with the use index of 1.95 points (index value growth of 18.2%).

IDI skills sub-index describes the literacy level of the population. This sub-index includes the following three parameters: adult literacy level, ratio of college students to the total quantity of population and ratio of the university students to the total quantity of population. These parameters are used as surrogate variables in order to evaluate human potential level and ability of the population in each country to use ICT. Unfortunately, these parameters provide only approximate evaluation of the actual skills of using communication technologies by the population, as the target values, such as literacy in ICT, are not being gathered yet. Therefore, when computing the IDI cumulative index, the skills use index is taken with the weight of 20% versus 40% weights for each of the other two sub-indices (access sub-index and ICT use sub-index).

In the CIS region, the coefficient of variation of IDI use sub-index is much lower (19.4%), then in Asia and Pacific (51.83%), Africa (46.98%) and Arab States (44,08%) – the second lowest globally after Europe (16.89%) – although it increased slightly from 2011 to

2012. Yet there is a quite a divide in terms of ICT development between countries such as the Russian Federation, Belarus and Kazakhstan, which feature in the global top 50, and, for example, Uzbekistan, which comes in 104th position in the IDI 2012.

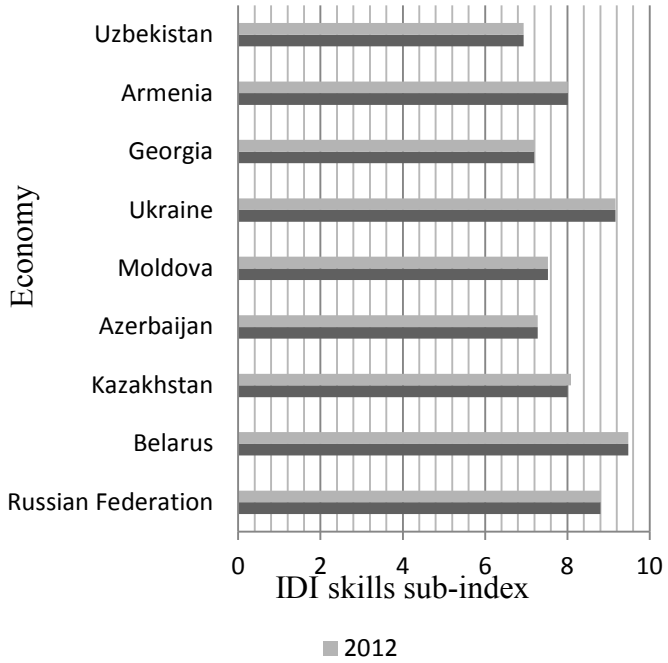

Chart 2 – IDI skills sub-index values in the Commonwealth of Independent States (CIS)

As of the end of 2012, the Russia Federation like in 2011 is on the 23 position of the rating with the value of 8.8 points. The Republic of Belarus has entered the top five of the countries with the highest scores of the parameter with its value of 9.48 points (107.7% from the level of Russia). Ukraine is steadily holding its rank 11– 9.17 points (104.2% from the level of the Russian Federation). Kazakhstan (8.09) and Armenia (8.01) are on positions 48 and 49. Azerbaijan and Moldova rank 68 and 60 in the rating with the respective sub-index values of 7.28 and 7.53, which are 17.3% and 14.4% below the level of Russia in terms of ICT use. As of the literacy level, the worst results belong to Georgia – 7.19 points and Uzbekistan – 6.9. Index of ICT skills use in Georgia is 11.9% lower the average index calculated for all the CIS countries and 22.4% lower the value of Russia. A sub-index of ICT skills use in Uzbekistan both in 2011 and 2012 have shown the lowest values in comparison to all the CIS countries and during both periods have been at the level of 6.94 points, which make only 79% of the value for Russia (chart 2).

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The present study of the IDI development index has led us to the following conclusions. The first, the results of IDI computing show that ICT development levels continue to grow all over the world, as almost all the countries have increased their IDIs during the period from 2011 to 2012. At the same time, there remain great differences in ICT access, ICT use and ICT-related skills. In 2012 the average IDI value of developed countries doubled the average value of developing countries. Russia scores the highest cumulative index of ICT development in 2012 in comparison to all the CIS countries.

The second, analysis of ICT readiness sub-index has revealed that despite the strong connection between the ICT development levels and income levels, government of the country is able to boost growth and implementation of ICT by means of creating, among the other measures, an open regulatory base? which favors competition and leads to reduction of prices, and by means of encouraging of private sector investments. So, in Russia the programs facilitated by the state helped to broaden the access to ICTs and their use. ICT access sub-index value for Russia in 2012 was of 6.73 points. Significant increase in the quantity of contracts for wireless broadband and fixed broadband communication provides a possibility to increase household access to ICT and their use, and also to attract more people to work in the Net.

The third, the largest divide in the values of countries is observed regarding the ICT use sub-index. The average value for developed countries in 2012 tripled the average value for developing countries. This discrepancy points at significant differences that exist between developed and developing countries in the number of Internet users and the quantity of fixed broadband and wireless broadband connection lines. Broadband access is still quite limited in many developing countries, and up to now some countries have not yet implemented the 3G wireless broadband networks, thus, in essence, cutting the options of attracting more people to work in the Net. However, at the same time one can observe the increase in ICT use sub-index in developed countries. For Russia in 2012 this parameter was of 4.34 points, which is the worst result in comparison to all the other sub-indices.

The fourth, values of ICT use skills index for developed countries vary very slightly, as these countries show a high level of literacy and a high level of coverage of population with ICT services. Nevertheless, this sub-index gives a good indication of the general level of human potential in the country. This information is of key importance as in addition to ICT infrastructure; a high level of education and ICT use skills is required for the efficient use of ICT and for building a model of a competitive and a comprehensive information society. Out of three sub-indices computed for Russia, only the index of ICT skills showed a considerably high value of 8.8 points in 2012.

Comparing the three sub-indices described above, you might notice that Russia holds a rather high rank only in the ICT skills index, which is twice as high as the index of ICT use and one third as high as the ICT access index. This is, first of all, connected with the small

number of Internet users in Russia in comparison to that of developed countries of the world. This tendency had negative impact on the quantity of subscribers, which have both fixed and mobile high-speed Internet access.

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CURRENT PROBLEMS OF POVERTY AND POPULATION DIFFERENTIATION INCOME IN RUSSIA

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This article investigates the problem of differentiation of the population of Russia in terms of income. Assessed the relation between wages, cost of living, the minimum wage. A comparative analysis of Russian subjects, the federal districts on specific gravity of the population with incomes below the subsistence minimum.

Keywords: poverty, living standards, differentiation, living wage, minimum wage, social security financing

Poverty of the population in the current economic and political situation as a separate region, the country and the world in general, occupies a leading position on the popularity of study.

Rapid economic growth, which was observed in Russia in the last decade, unfortunately, did not lead to a drastic reduction of poverty and inequality among the population. While absolute poverty decreased significantly (from 29% in 2000 to 11% in 2012). More than 15 million Russians (1 of 8 people) still live below the poverty line. (Fig. 1)

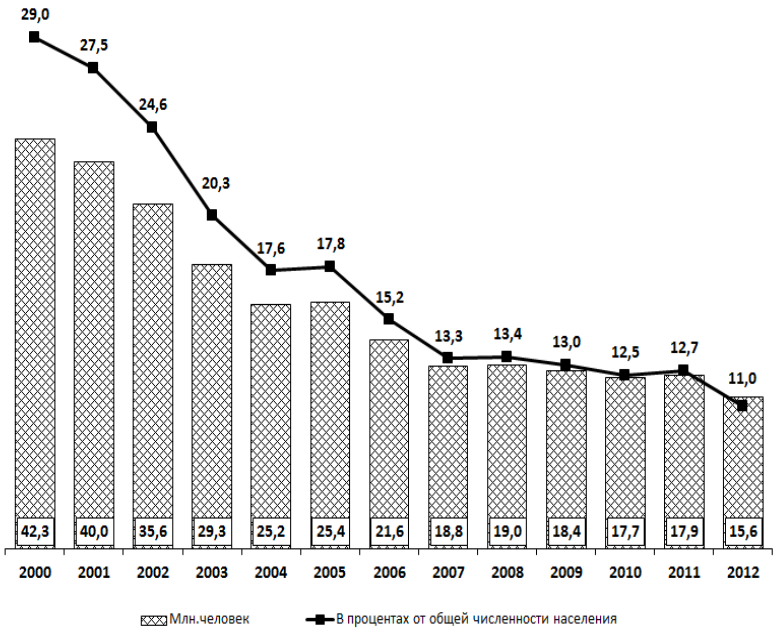

Figure 1 Dynamics of the population with incomes below the subsistence minimum [1]

Until 2013, the procedure for determining the minimum subsistence level and its purpose regulated by the Federal Law of October 24, 1997 № 134 -FZ "On the Subsistence Minimum in the Russian Federation". According to the Law, the subsistence minimum was a valuation of the consumer basket, as well as mandatory fees and charges. Table 1 shows the ratio of cash income to subsistence level. Evaluating the data in the table is easy to see that the per capita income and average wages higher than the subsistence minimum by more than 3.5 times. However, this is not a general welfare of its citizens. The reality is that the amount of subsistence can not live and survive, to spend money on a very modest food, utilities. Non-food products to the subsistence minimum purchase virtually impossible. [2]

Table 1

Value for money income to subsistence level [1]

Data	2009	2010	2011	2012
The subsistence minimum in the whole country	**5153**	**5688**	**6369**	**6510**
Per capita income of the population				
rubles a month	16895	18958	20780	22880
% of the subsistence minimum	328	333	326	351
Average nominal monthly wage per employee				
rubles a month	18638	20952	23369	26629
% of the subsistence minimum	334	341	340	378
Average pensions				
rubles a month	5191	7476	8203	9041
% of the subsistence minimum for pensioners	127	165	163	177

Since 2013 began to operate a new order of evaluation of the consumer basket, which is calculated on the basis of the subsistence minimum. According to the approved document, the minimum set of food is now measured in physical terms. Thus the cost of non-food items, which are included in the consumer basket, defined as half of the cost of food. Another quarter of the total cost of the basket accounted for consumed services.

Previously calculated in real terms the price of non-food goods. For example, how many

pieces of clothing a person should use for the year. New procedure for calculating, as explained in the decision", allows to take into account the actual changes in the value of non-food goods and services in the consumer basket."

In the annual food set for the working population in 2013 included 126.5 kilograms of grain products, more than 100 pounds of potatoes, 60 pounds of fruits and vegetables 114.6 kilograms and 58.6 kilograms of meat and 18.5 kilograms of fish, 290 liters of milk and 21 dozen eggs.

In the IV quarter of 2013, the subsistence minimum was 6705 rubles the national average and the ratio of per capita income to subsistence level was 409.8 %. In I quarter of 2013 in accordance with the new methodology, the subsistence minimum was 7095 rubles, which is more than the previous quarter by 5.8%, while the ratio fell to 304.1 %. Figure 2 shows that the value of the minimum wage does not reach the subsistence level. The difference between the average per capita income and the minimum wage of 500% (5 times)

One important moments secrete high levels of differentiation between regions Russian life. The poor in modern Russia compounded by the increasing level of socio-economic inequalities, which aggravates the subjective experience of poverty and significantly limits the ability of people out of poverty.

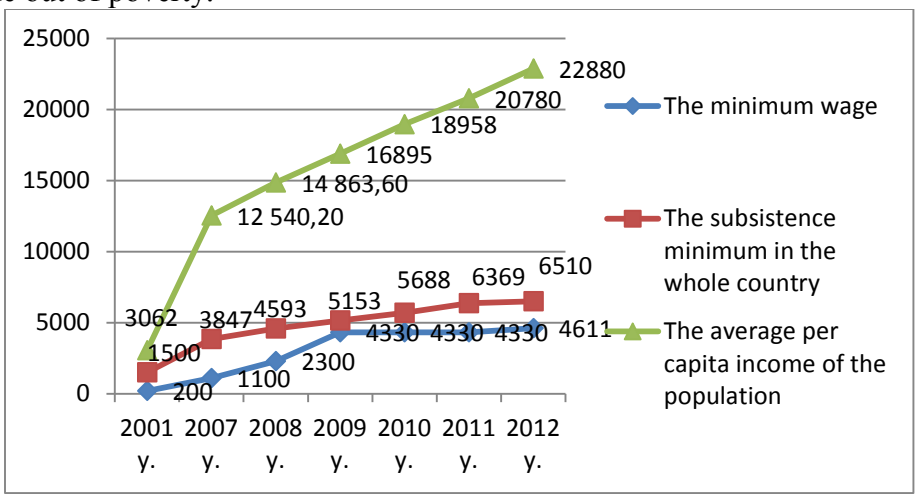

Fig. 2. Dynamics of the minimum wage, cost of living, per capita income for the years 2001-2012, rub.

Table 2.

Data on the proportion of the population with incomes below the subsistence minimum in Russia in 2009-2012,%

Data		**2009**	**2010**	**2011**	**2012**
RUS		**13,0**	**12,5**	**12,7**	**11,0**
CFD	**max**	Ivanovo region-22,7%	Ivanovo region–20,1%	Ivanovo region. –19,0%	Smolensk region.-17,5
	min	Lipetsk region. –9,9%	Belgorod region –8,2%	Belgorod region. –8,6%	Belgorod region. -6,6%
NWFO	**max**	Vologda Region. -18,2%	Vologda Region. -16,8%	Vologda Region. -17,1%	Pskov region -15,6%
	min	St. Petersburg –	St. Petersburg –	St. Petersburg –	St. Petersburg –

Data		**2009**	**2010**	**2011**	**2012**
		9,4%	8,6%	9,1%	9,2%
SFD	**max**	Republic of Kalmykia – 36,5	Republic of Kalmykia – 35,7	Republic of Kalmykia – 35,8	Republic of Kalmykia – 31,4
	min	Volgograd region.- 12,8	Volgograd region.- 14,0	Krasnodar region – 13,7	Republic of Adygea- 11,4
SKFO	**max**	Republic of Ingushetia– 26,0%	Republic of Ingushetia– 22,1%	Karachay-Cherkessia – 18,8%	Republic of Ingushetia– 17,1%
	min	The Republic of Dagestan -9,7%	The Republic of Dagestan -8,8%	The Republic of Dagestan -8,3%	The Republic of Dagestan -7,0%
PFD	**max**	Mari El Republic – 24,1	Mari El Republic – 24,0	Mari El Republic – 24,2	Mari El Republic – 20,4%
	min	Tatarstan -8,3%	Tatarstan - 7,7%	Tatarstan -8,1%	Tatarstan -6,7%
UFO	**max**	Kurgan region- 17,6%	Kurgan region- 16,9%	Kurgan region- 18,5%	Kurgan region- 15,8%
	min	Yamal-Nenets Autonomous District– 7,4%	Yamal-Nenets Autonomous District– 7,3%	Yamal-Nenets Autonomous District– 7,4%	Yamal-Nenets Autonomous District– 7,0%
SFO	**max**	Altai Republic– 31,1%	the Republic of Tuva-29,6%	the Republic of Tuva-30,6%	the Republic of Tuva-28,9%
	min	Kemerovo region. -11,7%	Kemerovo region. 11,0%	Kemerovo region. 11,6%	Kemerovo region. 10,7%
DVFO	**max**	Amur region– 22,9%	Amur region– 23,7%	Amur region – 20,4%	Jewish Autonomous Region– 19,5%
	min	Sakhalin region. - 11,5%	Chukotka Autonomous Area– 10,3	Chukotka Autonomous Area– 9,0:	Chukotka Autonomous Area– 9,5%
RUS	**max**	Republic of Kalmykia – 36,5%	Republic of Kalmykia – 35,7	Republic of Kalmykia – 35,8	Republic of Kalmykia – 31,4
	min	Yamal-Nenets Autonomous District – 7,4%	Yamal-Nenets Autonomous District – 7,3%	Yamal-Nenets Autonomous District – 7,4%	Tatarstan -6,7%
The number of regions "above average" in Russia		60	58	59	59

In Table 2, we systematized data for Russia as a whole and by federal districts. So , on the whole Russian population with income below the poverty level decreased by 13 % in 2009 to 11% in 2012. The Central Federal District Ivanovo and Smolensk regions have the largest share, Belgorod and Lipetsk regions - the minimum value of the district. In the North- West Federal District Vologda and Pskov regions have the maximum proportion of the population with incomes below the subsistence minimum, St. Petersburg - the minimum value. In the Southern Federal District of the Republic of Kalmykia stably occupies the maximum value is not only in the Southern Federal District, but also in Russia in general - more than 35% , the minimum value in different years, different regions are distinguished . In the North Caucasus Federal District maximum weight in the Republic of Ingushetia and Karachay-Cherkessia, but their value is lower than in the Republic of Kalmykia, Dagestan setting situation is better than in other regions of the North Caucasus Federal District. In the Volga Federal District, the most prosperous situation in the Republic of Tatarstan is the worst - in Mari El. In the Urals Federal District greatest level of "poor" people in the Kurgan region , the lowest - in the Yamal -Nenets Autonomous District , in Siberian District - respectively - Tuva Republic and Kemerovo region. In the Far Eastern Federal District of better things in Chukotka, worse - in the Amur region . In general, only 58-60 Russian regions share of the population with incomes below the subsistence minimum has a value greater than the national average, more than 70% . So, it turns out that in the Republic of Kalmykia most citizens with incomes below the subsistence minimum in the Yamal- Nenets Autonomous District and Tatarstan - the least.

According to the Federal State Statistics Service in April 2013. proportion of workers with wages below the minimum wage (5205 rubles), was 1.2 % against 1.8% in 2011. The highest share of workers with in April 2013 wages below the minimum wage, there was a communication (4.5%), agriculture, hunting and forestry (3.6%), activities, recreation, entertainment, culture and sports (3.2%), providing other community, social and personal services (3.0 %), education (2.2%), health and social services (1.4%). [1]

Proportion of workers whose monthly wages exceeded 25 thousand rubles, the average for the economy increased from 27% in April 2011 to 41% in April 2013. The largest proportion of workers whose wages amounted to more than 25 thousand rubles, marked in organizations mining - 75%, in the financial sector - 68% in research and development - 65%, transport - 58 % and in construction - 56%.

Poverty profile analysis (identification of populations at higher risk of poverty and the most numerous groups of the poor) Russian population leads to an important conclusion: the traditionally poor population groups with the highest risk of poverty and the largest deficit of income, but are not the most massive group in the total number of poor people in Russia.

Feature of poverty in Russia is that the largest group of the poor (50%) - the workers. The current model of poverty in the country - the result primarily of low income from employment. [4]

Sample survey organizations of the Federal State Statistics Service in October 2011. revealed that the average salary of employees was 22,717 rubles, of which employees are assigned to Category managers - 41700 rubles specialists - 23381 ruble other employees - 14 457 rubles, workers - 19,052 rubles. Average salary for managers of the organizations surveyed in 1.8 times higher than the salaries of specialists, 2.9 times - other employees and 2.2 times - workers. While in most economic activities average salary exceeded executives wages of workers in 1.9-2.8 times, in wholesale and retail trade; health and social services, organizations carrying out activities in Real estate, renting and provision of services, the ratio was 3.0-3.1 times, and in education - 3.6 times.

A survey of differentiation observed wages of workers in each category depending on the type of economic activity. The highest salary among the organizations surveyed in October 2011. was in the category of " leaders " in organizations engaged in the production of crude oil

and natural gas, the provision of services in these areas - 82459 rubles in air transport - 88406 rubles. Most lower-paid workers in the same category of staff were employees of organizations of textile and clothing production, wages which amounted to 29 % of wages " managers " of air transport organizations; 31 % of the wages of "experts" , 40 % - "working" and 53% - "other employees".

Factors associated with extremely poor situation on the labor market, low quality jobs are the dominant causes of poverty among the Russian population. Category of the working poor, on the one hand - a threat to the country's development, on the other side of the working poor has a special status in the social structure. To combat the economic poverty is necessary to use methods to these categories of people to raise their own revenues. This method is not social policies that help the poor traditional, and the result of economic growth. [3]

Growth in Russia is unbalanced, non-systemic, recurrent nature, sensitive to the changing external environment, creates prerequisites for growth increase productivity. The results of this growth is not reflected in the increase of competitiveness of Russian industry, improving the quality of life of the population, increases the social differentiation, does not contribute to poverty alleviation.

It is clear that radically change the situation with improved living standards is not possible, but it should be a gradual increase in the minimum wage, bringing subsistence to such an extent that they would citizen could meet their needs at the appropriate level. It is also important to continue the social policy of the state, where should occupy an important place social protection, the implementation of social security, pensions, health insurance.

Thus, we can conclude that without increasing the level and quality of life of citizens, particularly the poor, not creating conditions to reduce population differentiation in terms of income by geographic region, industry sector, cannot achieve economic growth, development, innovation, enhance competitiveness Russia at the world level.

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COMPARATIVE ANALYSIS OF THE RUSSIAN FEDERATION REGIONS TAKING INTO CONSIDERATION THE RISKS OF SOCIAL TENSIONS

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The article provides a critical analysis of the various approaches to quality of life. The expediency in obtaining adequate estimates of human development in the Russian regions considering the risks of social tension is proposed and justified. The composition, structure of risks of social tensions in the regions of the Russian Federation are given, their stable classification by the levels of risk is received, the features derived groups are analyzed.

Key words: risk assessment, human capital, human development, social tensions.

With the development of economic thought in the end of XX century scientists and economists put quality of life of its population in the heart of economic growth of the state. Subsequently, there was formulated variety of ways to quantify the quality of life of the population, the most common of which nowadays is a technique UN estimates the Human Development Index. The essence of the index calculated for all countries since 1990 is the aggregation of such socio-economic indicators as life expectancy at birth, adult literacy rate, enrollment in education, GDP per capita [1]. In addition, many authors proposed modified approaches to determining the quality of life, based on the Human Development Index. The main difference of these methods is the subjectivity meaningful definition of "human capital".

A number of studies based on high levels of human development are various derivatives of economic welfare. Particularly, in [11] the authors propose to consider the level of human development in the light of the level of poverty. On the basis of this approach of the method are official figures, characterizing the degree of inclusion of citizens to the poor (e.g., the minimum subsistence level). This technique is based on the effect of varying degrees of differentiation of the population by income to assess its propensity to consume. In addition, the authors' position is based on the fact that the differences between the regions in middle-income households are quite large. As disadvantages of this method the authors rank the possibility of overstatement of the subsistence minimum in order to request more resources from the federal budget, or use a lower poverty line for the purpose of balancing obligations to the population of the region and budgetary possibilities. This is due to the lack of a unified monitoring system used in the regions of approaches in determining the poverty criterion. In addition, incomplete statistical information by region is not sufficient reason for the formulation of statistically reliable conclusions when household budget survey, which reduces the accuracy of the assessments of the quality of life of the population in the regional cut [11].

Also in research [2] it is proposed to evaluate the economic welfare of the population through the gross domestic product. The author uses indicators such as "degree of GDP expenditure inflation process" and the absolute growth of GDP expenditure for the analysis of the rate of inflation, calculated on the basis of nominal and real GDP. These figures, according to the author, can serve as indicators of loss of society due to rising prices.

Moreover, in several studies the quality of life is offered to access by the state to assess the demographic indicators. Author [4] provides the tools to improve the demographic situation in the country, such as: the introduction of demographic ratings, showing the importance or significance of the social process or phenomenon.

Demographic situation is also reviewed by the authors as a basis for considering the quality of life [8]. In their work they offer economic and mathematical model for determining the cost of living for a worker to consider aspects of the problem, due to the premature loss of the individual in terms of lost profits from the region's economy as a whole.

The authors of [6, 7] propose to consider the level of education as the foundation of human development. Thus, according to the author [6], the economic, financial, military and political power of developed countries is directly dependent on the volume of fundamental research, the proportion of high-tech products in total industrial production and gross domestic product. The author introduces the concept of "intellectual potential", which is defined as "a set of human, material and financial resources, which are involved in two closely related key areas of intellectual life of society - science and education, and the measured value which shows created and stored in a society capacity for creative creation of new knowledge, technology products" [6, p.19].

In research [5] the author identifies the term "human development " as a process of improving human performance, meet their material and spiritual needs, motivation and incentives to achieve their goals for the sustainable development of both the individual and society as a whole, creating conditions to ensure a long and healthy life, to exercise their rights

to receive and knowledge, to participate fully in the process of income generation, as well as providing socialization and self-expression through work. As a statistical research, the category of human development is represented as process of meeting the needs of the human population in health, education, labor and access to resources [5]. In accordance with this definition, the author proposes a revised methodology for calculating the index of human development through the introduction of additional components - employment index.

Inclusion in the index model of employment is caused by the following reasons: currently in the process of production to the fore knowledge, responsibility, spiritual and moral potential. In this context, the employment rate is of interest from the point of view of the moral and ethical values. That employment, according to the author [5], is the most affordable way of self-survival and adaptation to the changing socio-economic situation.

In our opinion, an adequate assessment of the quality of human potential can only be done by taking into account the various spheres of life of the population. In addition, the proposed indicators should reflect the dynamics of the development of these areas. In this regard, we have developed an approach to the assessment of human development, taking into account the changes in the following aspects of social life: economic, educational, demographic, standard of living, as well as the risk of social tensions. Testing of this approach was carried out for the regions of the Russian Federation from 1994 to 2011. As the components responsible for the economic well-being of the population in the regions of Russia, were taken adjusted for cost of living and the core consumer price index value of the average nominal wage per employee for the full range of organizations. Educational level was assessed based on the proportion of the population with primary, secondary and higher vocational education in the total population of the Russian Federation regions, which was calculated according to the registration of qualified professionals institutions of primary, secondary and higher education [3]. Standard of living was introduced by population consumption of staple foods: potatoes, vegetable oil, milk and dairy products, meat and meat products, vegetables and melons, fish and fish products, sugar, fruit and berries, bread products. Demographic component was calculated as the geometric mean health regions of Russian Federation and fertility levels. In turn, the health of the population was estimated according to the ratio of mortality to incidence on the main classes of diseases: infectious and parasitic diseases, diseases of the circulatory system, neoplasms, respiratory diseases, digestive diseases, external causes. Methods of assessing the level of human development in the Russian Federation regions for the period 1994 to 2011 is described in detail in [9].

An integral part of public policy to achieve a high standard of living is guaranteed to ensure its security, i.e. minimize the potential risks of social life. These risks primarily include crime; morbidity socially significant diseases such as alcoholism, drug addiction, tuberculosis, HIV infection, etc.; deaths from unnatural causes (homicide, suicide, alcohol poisoning, etc.) Because of this, we believe appropriate in the framework of the developed approach to include consideration of the risk of social tensions show when assessing the level of human development in the regions of the Russian Federation.

At the risk of social tensions were taken into account the following indicators by region for the period 1994 to 2011. (per 100 000 people):

– random alcohol poisoning;

– suicides;

– all kinds of traffic accidents;

– crime (murder and attempted murder, intentional infliction of grievous bodily harm, rape and attempted rape, robbery, theft, economic crimes, crimes related to drug trafficking);

– contingents of patients with alcoholism and alcoholic psychosis;

– contingents of drug addicts;

– other external causes risk of social tensions (all the external causes of death without taking into consideration the causes, mentioned above).

Preliminary statistical analysis has revealed correlations between social tensions following characteristics: suicides and accidental alcohol poisoning, a contingent of drug addicts, alcoholism and alcoholic psychosis and crime, crime and other external causes of patients with alcoholism and alcoholic psychosis and other social causes.

Received direct dependencies indicate that with the increasing incidence of alcohol and drug abuse population in the regions of the Russian Federation is also experiencing an increase in crime and suicide and other negative social consequences, which certainly reduces the quality of life of the population.

During the preliminary investigations there were substantiated assumptions about the risks of social tension depending on age and sex. In particular, deaths from drug abuse reach its peak in the age group 24-29 years, and alcoholism - in 50-54 years, etc. [10]. Russian Federation regions are heterogeneous in age and sex composition of the population, so the purpose of comparing them to the risk of social tensions in the adjustment was carried out on selected indicators mean age. The adjustment coefficients for a component which depends on the level of middle age are presented in Table 1.

Table 1

Coefficients of dependence of indicators of social tensions and the average age of the population in the regions of the Russian Federation (per 100,000 people)

The components	Adjustment coefficients
Contingents of patients with alcoholism and alcoholic psychosis	0,629
Contingents of drug addicts	-0,155
Suicides	-0,767
Random alcohol poisoning	0,147
All kinds of traffic accidents	0,0056

According to adjusted indicators there were analyzed the structure of the risks of social tension in Russian Federation between 1994 and 2011 whose results are presented in Table 2.

The largest share in the risks of social unrest is crime (49.6% of the risk of social tensions in 1994 and 50.3% in 2011 or 1682.00 per 100 000 population). Also of note is the high percentage of patients with alcoholism and alcoholic psychosis, the number was 43.3% of the risks taken into account social tensions in the regions of the Russian Federation in 1994 and 39.3% in 2011 (1314.35 per 100 000 population). The smallest share of the risks of social tension was noted for all kinds of traffic accidents - 0.8% in 1994 and 0.6% in 2011, respectively.

Table 2

Structure of risks of social tension in regions of Russian Federation

Component of social tension per 100,000 people	Weight of component in the total share of risks social unrest in 1994	Weight of component in the total share of risks social unrest in 2011
Random alcohol poisoning	0,9%	0,4%
Suicides	1,1%	0,7%
All kinds of traffic accidents	0,8%	0,6%
Crime	**49,6%**	**50,3%**

Contingents of patients with alcoholism and alcoholic psychosis	**43,3%**	**39,3%**
Contingents of drug addicts	0,4%	6,0%
Other external risks	3,9%	2,6%

We should pay attention to this component of social tension as contingents of drug addicts, whose share in 1994 was 0.4% and in 2011 – 6.0% (199.76 cases per 100 000 population).

The changes in the dynamics of the absolute values of the considered risk-adjusted social tensions averaged by region are presented in Table 3.

Table 3

Dynamics of risks of social tension in Russian Federation between 1994 and 2011.

Component of social tension per 100,000 people	Risk value ($\cdot 10^{-5}$) over a period				The total growth rate risk from 1994 to 2011.	Coefficient of variation
	1994	2000	2005	2011		
Suicides	39,5	37,6	31,4	21,8	-44,9%	44,7%
Random alcohol poisoning	38,3	25,9	28,7	11,4	-70,2%	57,3%
All kinds of traffic accidents	28,7	26,4	26,4	20,5	-17,7%	27,5%
Crime	1775,0	2014,0	2477,0	1682,0	-5,2%	28,9%
Contingents of patients with alcoholism and alcoholic psychosis	1663,2	1520,4	1535,2	1304,3	-21,6%	37,3%
Contingents of drug addicts	10,0	186,3	229,5	220,1	2097,7%	69,2%
Other external risks	139,4	126,8	135,4	66,0	-52,6%	22,5%

For Russian Federation the greatest negative effects provide such risks social tensions as crime and the incidence of alcoholism. In this case, if the incidence of alcoholism in this period is characterized by a significant reduction in risk (~ 20%), the risks for the crime remained virtually unchanged, remaining at the level of around $2005 \cdot 10^{-5}$.

It should be noted that the risks of drug addiction in the regions of the Russian Federation for the period increased significantly, about 22 times, which is, most likely diagnosis forced this group of patients.

Risks of suicide, all kinds of traffic accidents, alcohol poisoning and death from other socially significant diseases in this period also declined.

It should also be noted that the risk of social tensions there is a strong differentiation of regions of the Russian Federation. Variation of Russian regions by the number of drug users was 69.2%, the number of accidental alcohol poisoning - 57.3%, etc. (See Table 3).

Minimal risks for all of the components of social tension in the period from 1994 to 2011 were recorded in regions such as the Republic of Kabardino-Balkaria, North Ossetia, Dagestan and Ingushetia (see Table 4).

Table 4

Comparison of average for the period 1994-2011 risks of social tensions in the regions with the lowest values of indicators
relatively to the median level of the Russian Federation ($\cdot 10^{-5}$)

Component of social tension per 100,000 people	RF	Republic of Dagestan		Republic of Ingushetia	
		value	deviation	value	deviation
Random alcohol poisoning	26,76	2,4	-91,2%	2,2	-91,6%
Suicides	35,09	4,3	-87,8%	1,0	-97,2%
All kinds of traffic accidents	21,83	21,2	-3,0%	14,9	-31,7%
Crime	2046,50	558,3	-72,7%	422,6	-79,4%
Contingents of patients with alcoholism and alcoholic psychosis	1582,56	350,5	-77,9%	20,1	-98,7%
Contingents of drug addicts	120,35	108,1	-10,2%	56,9	-52,7%
Other external risks	123,16	40,5	-67,1%	29,9	-75,7%

The greatest risks, significantly exceeded the national level, have been observed in regions such as the Republic of Altai, Tyva, Samara, Irkutsk, Kemerovo region, Perm. In these regions there were recorded the maximal of all Russian Federation death rates from accidental alcohol poisoning, traffic accidents, and significantly exceeded the national crime rate (see Table. 5).

Table 5

Comparison of average for the period 1994-2011 risks of social tensions in the regions with the highest values of indicators
relatively to the median level of the Russian Federation ($\cdot 10^{-5}$)

Component of social tension per 100,000 people	RF	Republic of Tyva		Altai Republic	
		value	deviation	value	deviation
Random alcohol poisoning	26,76	66,6	148,8%	61,6	130,3%
Suicides	35,09	80,7	130,0%	52,8	50,5%
All kinds of traffic accidents	21,83	33,1	51,7%	51,2	134,3%
Crime	2046,0	2453,6	19,9%	2566,4	25,4%
Contingents of patients with alcoholism and alcoholic psychosis	1582,6	1955,3	23,6%	1701,6	7,5%
Contingents of drug addicts	120,35	145,0	20,4%	251,6	109,1%
Other external risks	123,16	128,2	4,1%	171,4	39,1%

Due to significant differentiation of Russian regions in terms of the risk of social tension is was decided to hold their clustering characteristics under consideration, taking into account changes of recent in the dynamics.

Based on available data for 1994-2011 regions were divided into 3 groups according to the level of risk of social tension. Their distribution is shown in Table group. 6. The largest group - the third, the smallest - the second.

Table 6

Distribution of the regions of the Russian Federation on the risks of social tension in average years 1994-2011

Group 1	Moscow, St. Petersburg; **Republics:** Adygea, Bashkortostan, Kabardino-Balkaria, Kalmykia, Karachay-Cherkessia, Mordovia, Sakha (Yakutia), North Ossetia, Tatarstan; **Regions:** Belgorod, Volgograd, Voronezh, Kursk, Murmansk, Orenburg, Rostov, Saratov, Ulyanovsk; **Territories:** Krasnodar, Stavropol.
Group 2	**Regions:** Astrakhan, Irkutsk, Kemerovo, Kurgan, Novosibirsk, Omsk, Sverdlovsk, Tomsk, Tyumen, Chelyabinsk; **Territories:** Altai, Krasnoyarsk, Primorsky, Khabarovsk.
Group 3	**Republics:** Altai, Buryatia, Karelia, Komi, Mari El, Udmurtia, Chuvashia, Khakassia; **Regions:** Amur, Arkhangelsk, Bryansk, Vladimir, Vologda, Ivanovo, Kaliningrad, Kaluga, Kirov, Kostroma, Leningrad, Lipetsk, Moscow, Nizhny Novgorod, Novgorod, Orel, Penza, Pskov, Ryazan, Smolensk, Tambov, Tver, Tula, Yaroslavl; **Territories:** Trans-Baikal, Kamchatka, Perm.
Untypical regions	**Republics:** Dagestan, Ingushetia, Tuva; **Regions:** Magadan, Samara, Sakhalin, Chukotka Autonomous district, Jewish Autonomous region.

For further analysis of all components of social tensions were reduced to aggregated index as their geometric mean. In the Republic of Dagestan and Ingushetia there were obtained minimum value of this indicator for the period. In the Republic of Tyva and Altai there were marked maximum index levels of social tension (see Fig. 1).

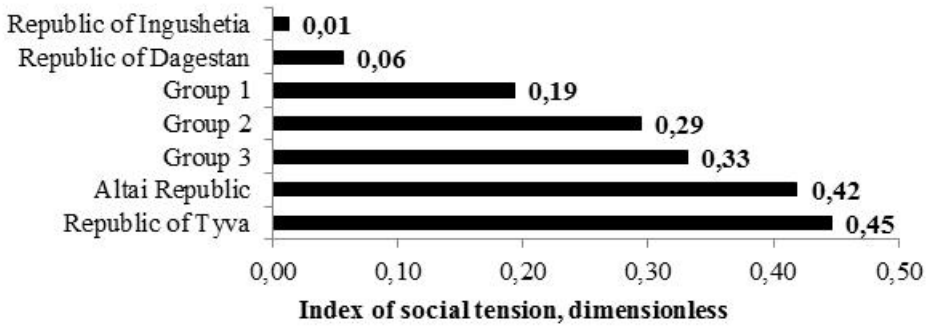

Fig. 1. A comparison of the index of social tension in the regions and groups in the subjects with the lowest and highest levels of it, averaged over the period from 1994 to 2011

It should also be noted that in a number of Russian regions, which were atypical, sharply deviate from the Russian average value of a particular component of social tension. In particular, in Sakhalin, Magadan and Chukotka Autonomous district several times exceeded the level of the RF patients with alcoholism and alcoholic psychosis. Samara region differs from other regions of high rates of drug addicts. The number of suicides, crime and all kinds of traffic

accidents in the Jewish authors region is higher than those obtained by any of the regional groups.

Figure 2 shows the profiles obtained by groups of regions on the components of social tension.

The first group of regions could be related to favorable for this indicator. It levels the risk of social tensions below the average in the Russian Federation values:

– random alcohol poisoning – на 55,6%;
– suicides – на 32,9%;
– all kinds of traffic accidents – на 1,3%;
– crime – на 25,7%;
– contingents of patients with alcoholism and alcoholic psychosis – на 21,8%;
– other external risks – на 20,1%.

However, the number of drug addicts in this group of regions average 1994-2011 4.0% above the national average.

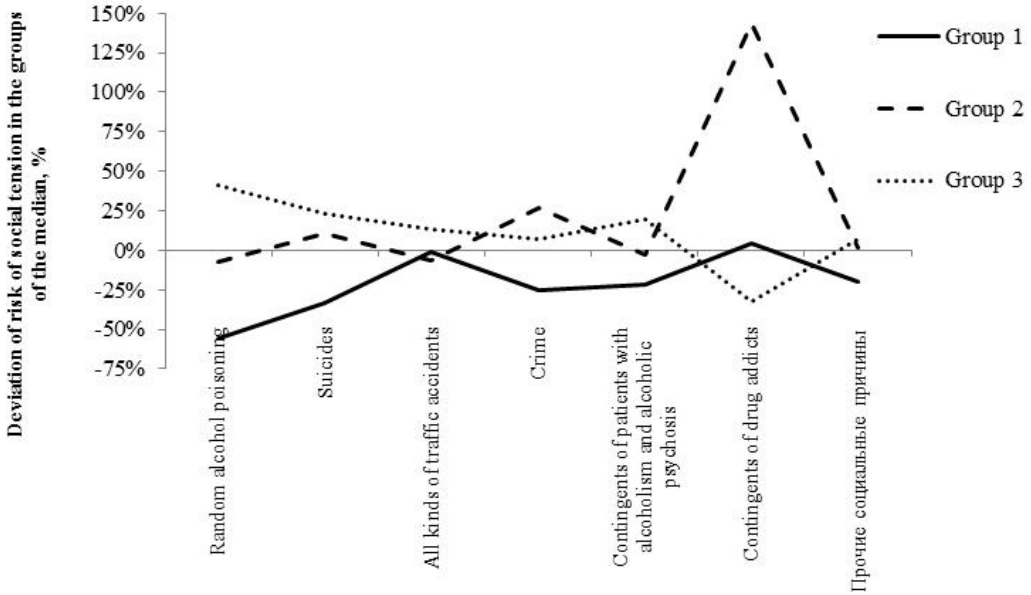

Fig. 2. A comparison of groups centroids of Russian regions by the level of risk of social tensions regarding the average values of the average for 1994-2011 years.

In the second group there were marked regions comparable with the average risk level of social tension. The following components were recorded in Russia exceeded the average values:

– suicides – на 10,6%;
– crime – на 26,7%;
– other external risks – на 1,7%.

Additionally, this group of regions showed significant excess of the Russian Federation on the number of contingents of drug addicts at 143.8%.
Risks of social tensions below the Russian level were determined by the components:

– random alcohol poisoning – на 7,1%;
– all kinds of traffic accidents – на 6,4%;
– contingents of patients with alcoholism and alcoholic psychosis – на 3,2%.

The third group was assigned to regions disadvantaged by considers the risk of social tensions, as it greatly exceeded all-Russian level for all components except the contingents of drug addicts, whose number is below the average level in Russia by 32.5%.

Exceeding the remaining components of the composition was:

– random alcohol poisoning – на 41,5%;

– suicides – на 23,0%;
– all kinds of traffic accidents – на 13,7%;
– crime – на 6,9%;
– contingents of patients with alcoholism and alcoholic psychosis – на 19,3%;
– other external risks – на 6,7%.

Table 7 shows the comparison of the period 1994-2011 risk of social tension in groups of regions with an average level of Russian Federation in absolute and relative terms.

Table 7

A comparison of average for the period 1994-2011 risks of social tension in groups of regions with respect to the average level in the Russian Federation ($\cdot 10^{-5}$)

Component of social tension per 100,000 people	RF	Group 1		Group 2		Group 3	
Random alcohol poisoning	26,76	11,9	-55,6%	24,9	-7,1%	37,9	41,5%
Suicides	35,09	23,5	-32,9%	38,8	10,6%	43,2	23,0%
All kinds of traffic accidents	21,83	21,5	-1,3%	20,4	-6,4%	24,8	13,7%
Crime	2046,0	1521,3	-25,7%	2592,6	26,7%	2187,9	6,9%
Contingents of patients with alcoholism and alcoholic psychosis	1582,6	1238,0	-21,8%	1532,4	-3,2%	1888,3	19,3%
Contingents of drug addicts	120,35	125,1	4,0%	293,4	143,8%	81,3	-32,5%
Other external risks	123,16	98,4	-20,1%	125,3	1,7%	131,4	6,7%

The results obtained suggest an enough strong differentiation of the Russian Federation regions on the level of risk of social tensions having regard to the component. It testifies to their sensitivity to taking place in regions adverse social events, and determines feasibility of incorporating the developed aggregate index of social tension in range of indicators in determining the level of human development of the Russian Federation regions along with such spheres of life of the population of the Russian Federation, as the economic and living standards, education, demographic.

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SIMULATION MODELING SYSTEM OF THE LIFE QUALITY DYNAMICS

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There are considered actual problems of the life quality researches. There are analyzed the existing approaches to researching and modeling of the life quality. There is developed a cognitive model of the index formation of the life quality. There is developed the structure and the software of simulation system to study the dynamics of the life quality at the changes in the life conditions and the influence of external factors.

Keywords: life quality, cognitive model, integral index, interaction dynamics, simulation modeling system

Further reform of Russian society, economic and social development of the country largely depends on the life quality, improve the management of these processes at the federal, regional and municipal levels.

Appealing to the problems of the life quality is especially important for Russia undergoing a period of restructuring, transformation of social policy models, search for new directions, ways and mechanisms for socio-economic development.

Problems of life quality have become the object of study of various sciences in the second half of XX century. There are following research areas:

- study the effect of scientific and technological progress and economic growth of the society on the life quality;
- study the impact of sociocultural factors on the life quality;
- detection the environmental component of the life quality in modern society;
- analysis the socio-psychological component of the life quality;
- study interdependence problem of the life quality and human health;
- development the indicators and methods of the life quality rating;
- analysis management problems of the life quality.

The life quality is a key socio- economic category, characterizing the structure of human needs and their satisfaction. Significant advantages of the life quality are, firstly, the ability to analyze the dynamics of its changes in order to determine the vector of society development, and secondly, the ability to analyze individual components of the life quality, which can be graded when they are brought together and leave outside other unsolved problems in some aspects of social life.

At the same time the diversity of the concept of "the life quality", the impossibility of its direct quantitative measure, taking into account a large number of interrelated and interacting objective and subjective factors affecting the index of the life quality determine the complexity of rating and significant difficulties in interpreting the results.

Category "the life quality" may include several tens of indices. There are three approaches to rating (measurement) of the life quality: objective (statistical or quantitative), subjective (qualitative) and integral (complex).

Objective or quantitative approach is the most widely used among all the methods of research, as based on the study and analysis of statistical data and can be used to compare regions and countries. However, at present there is no standard range of the life quality and their rating criteria at the level of Russia and the Federation subjects.

Subjective or qualitative approach is consists of the study satisfaction of the basic constituents of the life quality with sociological or expert methods and allows study the public opinion about the existence conditions, the degree of satisfaction of the life quality, completeness and quality of goods and services. Unlike the statistical data the real rating about the life quality reflects not only the rate of their level of consumption of material , cultural and other benefits , but also their degree of satisfaction with the quality, completeness and timeliness of these benefits.

The integrated approach includes the advantage of objective and subjective approaches and permits to consider the problem in detail from the objective conditions of existence, and from the point of view of satisfaction with the people in these conditions.

According to the integral approach the life quality is defined as "the complex characteristic the living conditions of the population and which is expressed in terms of objective and subjective rating of satisfaction of material, social and cultural needs and is connected with the people's understanding of their position depending on the cultural characteristics, values and social standards prevailing in society" [1]. The development problems of the methodological foundations for constructing integral indices of the life quality are mostly given in the works by Aivazyan [2]. Despite the fact that the integral indices of the life quality have a limited value and conditional meaning, but they are necessary for solution of specific types of tasks.

The present day, there is developed a large number of models for the life quality rating. The essence of approaches for modeling the life quality is as follows [3]:

- building the models of individual components of the life quality and the integral index as a whole;
- modeling interconnection between the life quality and its factors as well as analysis of relationships between indices of the life quality;
- multicriteria classification of objects according to the standards of the life quality;
- analysis of trends and forecasting tendency to the life quality.

Due to the fact that the life quality index has a hierarchical structure the process supposes the development of models of several levels [3].

Models of the first level - the simplest models with a limited number of variables, allowing to get a particular characteristic of the individual properties of the life quality - for example, the calculation of fertility, degree of satisfaction needs and etc.

Models of the second level provide more generalized characteristic of a particular aspect of the life quality. At the same time received integrated indices are more conditional and assume a larger set of variables, as well as the use of more complicated mathematical methods. An example is models of the life time.

Models of the third level has a larger set of variables and more complicated mathematical methods, they have a greater degree of convention of the resulting index and obtain an integral characteristic of several aspects of the life quality. For example, an index of population quality shows the integral characteristics of health, education, demographic, etc. Accordingly, models of the third level are a set of more complex model structures. A calculating model of the human development index belongs to the models of the third level.

Models of the fourth level claim to receive the most integrated indices reflecting all the basic components of the life quality. The example is the model by S. Aivazyan [2].

A dynamics model of the life quality has been developed in the researches using the systematic, cognitive and synergistic approaches. As a result of the structuring of the problem area there are defined the following interrelated components of the life quality index: a degree of satisfaction of primary human needs, a degree of satisfaction of secondary human needs and a degree of security with necessary resources for satisfaction those needs. The interaction of these components forms an integral component of the life quality. The feature of the proposed model is that each of the separated components of the life quality and an integral index of the life quality are dynamic objects and they have their own mechanisms of self-organization [4]. Dynamics of interacting components of the life quality is described by nonlinear differential equations.

For experimental studies there is developed the automated simulation system (ASIM) for study the dynamics of the life quality with changing the life conditions and by the action of external factors [5]. The main requirements for ASIM are, firstly, the use of methods of visual simulation for interactivity with the model and the observations the experiment in time, secondly, the presentation of simulation results in useful for, and thirdly, the presence of background information about the model and support the user actions.

The software ASIM is developed in the mathematical modeling Matlab, the choice of which is due to its following features:

- built-in high-level programming language provides a convenient means for the development of algorithms, including the use of the concepts of object-oriented programming;
- the package includes a large number of functions for graphics rendering, including 3-D and visual data analysis tools;
- the interactive tool Simulink for modeling, simulation and analyzing of complex dynamical systems is integrated in Matlab for building graphical block diagrams, simulating the behavior of the complex systems, investigating their characteristics and improving designs.

The automated simulation system consists of the following modules: dialog windows for input/output of information, which includes a main window, an edit window for the model parameters, a display window for modeling results, auxiliary windows; a model of the life quality dynamics; a directory; user manual. ASIM structure is shown in Figure 1.

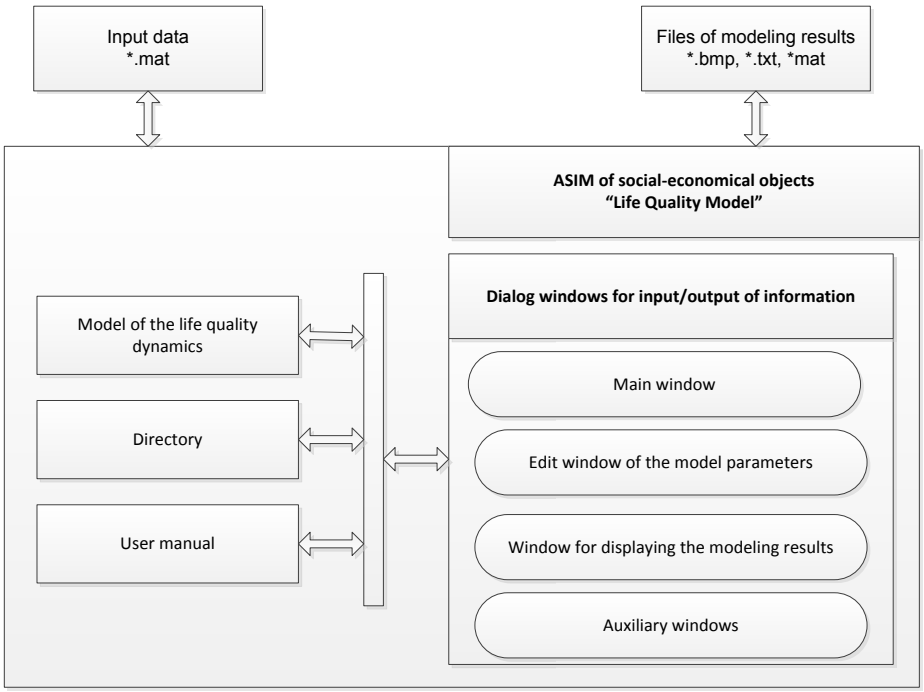

Figure 1 – ASIM structure «Life Quality Model»

The main model of ASIM is a dynamics model of the life quality index designed in MATLAB Simulink. A calculation of transients and phase portraits of the system is provided in it. Before modeling it is necessary to set the values of connection coefficients, the value of the input, time and a modeling step.

Let's consider the functioning algorithm of the main module (fig. 2).

When the program starts the model of the dynamics of the life quality is loaded and the file is checked. If there is no file, an error is displayed and the user can choose to load another file. If the file is loaded successfully the file with the values of the coefficients is loaded, the warning is displayed.

Then the main menu of the program is loaded, the user has an opportunity to select one of the following options:

- to change the model parameters;
- to research;
- to display the results;
- to save the current mode of operation;
- to escape the program.

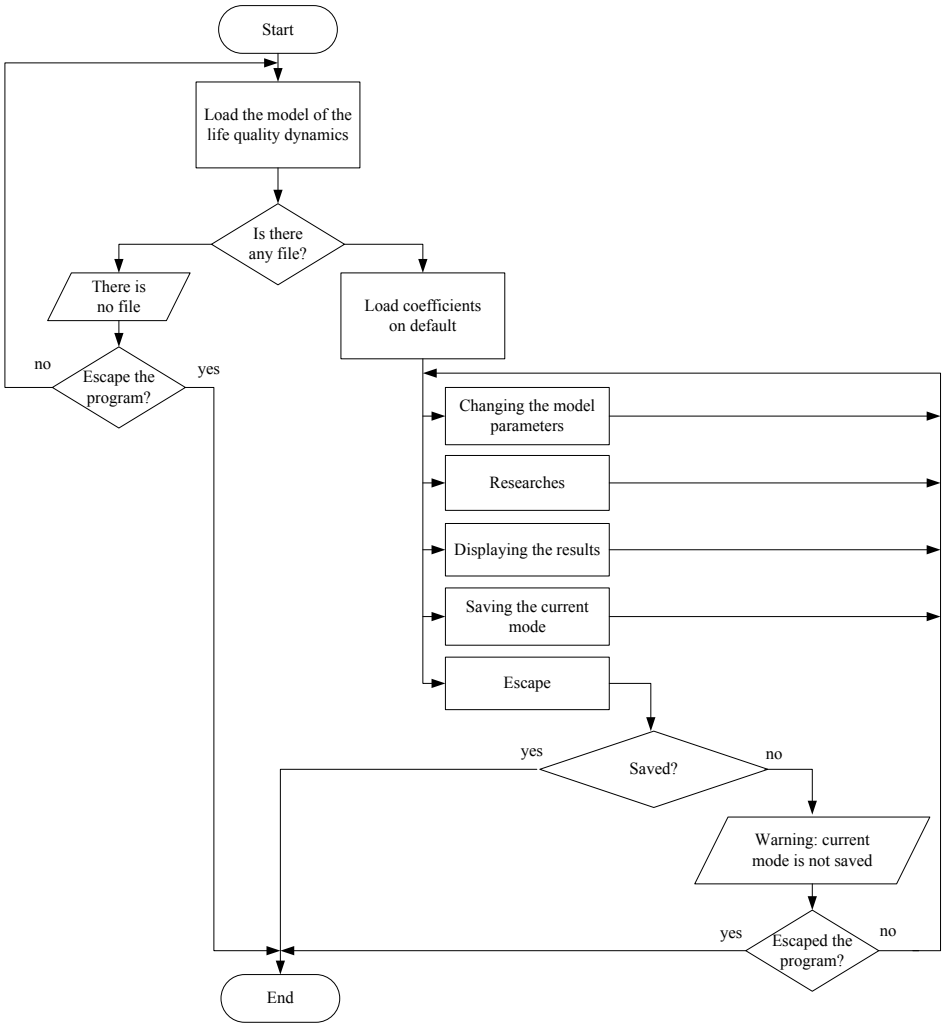

Figure 2 – Algorithm of the main module

If you select "escape" the program checks for saving the current mode of the model operation. If the last changes of the model parameters have not been saved, a warning is displayed and a request for confirmation escaping the program.

The graphical user interface is given in a form of dialog windows of information input/output. In the system there are four types of dialogs: a main window, an edit window for the model parameters, a display window for modeling results, auxiliary windows.

The main window is displayed when the program starts. For user convenience, it has brief theoretical information about the model of the life quality. The main window also provides the user with access to the main functions of the program.

The edit window of the model parameters is displayed when you select the corresponding function in the main program window. This window also contains brief theoretical information. The window has fields for input the model coefficients and the values of the input action on the subsystems, as well as control buttons.

Output of the modeling results is done by selecting the corresponding function in the main program window. In this case there are two output modes - numerical and graphical. In the numerical mode the modeling results are presented in tabular form containing the values of transients and their derivatives. In the graphical mode the transients and phase portraits are displayed. The modeling results can be saved as a file, as a table or a picture.

The auxiliary windows are dialog windows for loading, saving files, notifications, errors, approval request, window for selection of results output and others.

The developed simulation modeling system serves to complex researches of the life quality dynamics at the changes of its individual components, to study the influence of various external and internal factors on the life quality.

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APPLICATION OF OPEN SOURCES OF INFORMATION FOR CALCULATION OF SOCIAL TENSION OF SOCIETY

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In this article is described the method of calculation of the social tension indicator on the basis of data from open sources for the purpose of an assessment of probability of emergence of civil excitements and wars. Work is performed with financial support of the Ministry of Education and Science of the Russian Federation on the state contract of 10.10.2013 No. 14.514.11.4113 within the FTP "Researches and developments on the priority directions of development of a scientific and technological complex of Russia for 2007-2013".

Keywords: social tension, data from open sources, conflict level.

As social tension understand the characteristic of a condition of the social system, being expressed in increase of its instability caused by violation of the human rights on satisfaction of their requirements. The phenomenon of social tension is a subject of complex research. Dynamics of social tension can lead to development of social contradictions when is noted the frictionless form of manifestation and overcoming. It testifies only to existence of possibility of the conflict expansion, is the prerequisite, accompanies process of its development, but not always leads to the conflict. It is necessary to control it constantly (through the analysis and forecasting) and to regulate (through management).

Social tension, reflecting level of stability/instability of social system, degree of its predisposition to change (being the indicator of stability of concrete social system), becomes object of social management. As the independent social phenomenon of social tension demands the scientific analysis. It is necessary to influence elaborately, in due time to expect and prevent dangerous tendencies of its growth. Improvement of methodology of the analysis of social tension, development of techniques of definition of its level, tendencies of development and forms of manifestation acts as one of the most important conditions of control over its state.

The majority of method of calculation of social tension is used as basic data by results of polls, and for calculations – statistics methods. There are also approaches of foreign authors

using the regression analysis, and also entropy methods for an assessment of extent of polarization of the population. Besides, there are models (Esteban, 2011), connecting polarization, an inequality and the conflict and estimating degree of balance and use of an average weighed. In this work were used three approaches to an assessment of level of social tension: use of physical methods (for an assessment on one factor – differentiation of the income), methods of statistics and cybernetics methods (for a complex assessment on a number of factors).

Preliminary selection of the factors influencing on social tension level, is carried out by method of expert judgements on the basis of the analysis of historic facts and official statistical information. Selection of the most significant factors for inclusion in complex model of social tension level on the basis of the regression analysis and in model of social tension level on the basis of entropy approach is carried out by means of the correlation analysis. The analysis of open sources of information showed that the most reliable, full and available source of information is Goskomstat database from which it is possible to carry out collecting objective statistics without financial expenses, without addressing to methods of poll of the population which are expensive. As initial information for carrying out calculations with application of the developed model were chosen the following indicators:

1. Income distribution:

a) population distribution in size of the average per capita monetary income;

b) distribution of total amount of the monetary income on 20 percentage groups of the population;

c) coefficient of funds (ratio of the monetary income of 10% most and 10% of the least wealthy population);

d) Gini coefficient (index of the income concentration).

2. Unemployment:

a) total number of the unemployed;

b) unemployment rate (in %).

3. Gross Domestic Product (GDP):

a) Gross domestic product of Russia per capita at par purchasing power;

b) Gross domestic product of Russia at par purchasing power;

c) parity of purchasing power (Russian rubles for 1 US dollar).

4. Strikes:

a) losses of working hours for the workers who have been directly involved in a strike for the reporting period;

b) the number of the workers who have been directly involved in a strike;

c) number of the organizations on which there were strikes.

In Fig. 1 is presented use-case the chart of process of data acquisition of indicators from open sources.

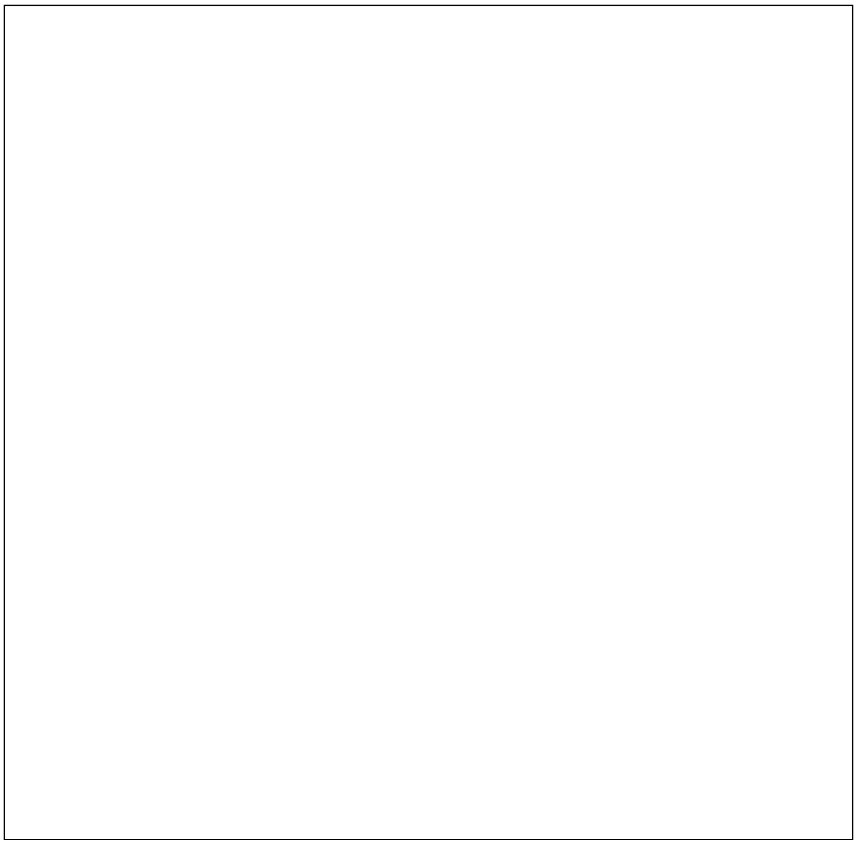

Figure 1 – The chart of use variant of data acquisition process from open sources

Information received from open sources is brought in storage of data. As entrance data are used data from open sources (for example, presented in an open database of Goskomstat) in a format: *.xls. In Fig. 2 is shown the interrelation of the tables entering into physical structure of data of the information base scheme.

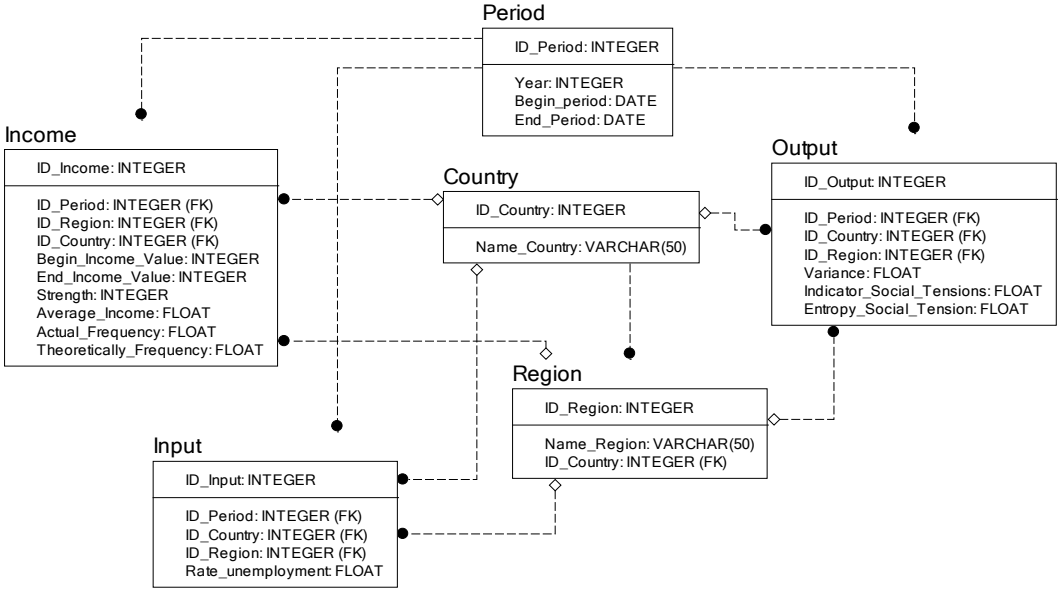

Figure 2 – Physical structure of data of the information base scheme

The name and designation of the tables containing entrance data of information base are provided in table 2.

Table 2 – Name and purpose of tables of entrance data

Name	Purpose of tables
Country	Reference book of the countries
Region	The reference book of the regions (subjects) entering the country
Period	Time periods for which the indicator of social tension pays
Input	Entrance data for a certain period of time
Income	Level of the income

Calculation of social tension level on income differentiation of the is carried out according to the following mathematical model [1]:

$$\delta_{ST} = \sum_{j=1}^{k} \left| f_j - f_j' \right|$$

where f_j – frequency according to actual data by every year of the population in j group of the income, and in a formula we use values $f_j \le \bar{f}$;

f_j' – theoretical frequency by every year of the population in j group of the income, and in a formula we use values $f_j' \le \bar{f}$. Pays off on a formula

$$\hat{f}_j = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{ -\left[\frac{\ln X_i - \ln \bar{X}}{\sigma\sqrt{2}} \right]^2 \right\}$$

$\bar{f}$ – population frequency according to the actual data, corresponding to the average level of the income;

$\hat{f}$ – theoretical frequencies;

σ^2 – the dispersion counted on a formula:

$$\sigma^2 = \frac{\sum_{j=1}^{k} (\ln X_j - \ln \bar{X})^2 \cdot f_j}{\sum_{j=1}^{k} f_j}$$

where X_j – income level in *j* group of the income;

$\bar{X}$ – average level of the income.

For calculation of complex model of social tension is used entropy approach. In developed information system the model constructed also on the basis of entropy approach, allows to estimate level of social tension on a complex of various factors:

$$H_c = \sum_{i=1}^{n} p_i \log_2 p_i$$

where p_i – probability of the *i* level of the factor influencing social tension level. The complex model joins an indicator δ_{ST} (social tension level on the income differentiation).

The described technique was cornerstone of program realization of an social tension assessment of the Russian Federation [2]. Program realization of algorithm is intended for an

assessment and forecasting of social tension level at various management levels – the state, the region, the enterprise – for the purpose of prevention of conflict situations emergence. Representation of social tension exists as the indicator of social system stability and as the object of management. Detailed studying of features of its growth, the analysis of tendencies of manifestation of social activity in regions of modern Russia will allow to predict protest activity of the population, to reveal threats actual for the region and risks, in due time to react to undesirable situations. Program realization consists of three logical blocks (modules) on number of solved tasks:

1. Module of calculation of the income distribution parameters;
2. Module of calculation of an indicator of social tension level;
3. The module – reports is for viewing of values of indicators in dynamics.

As a result of performance of calculation procedure of social tension and entropy is formed the report containing indicators of social tension with visualization of result (Fig. 3, 4).

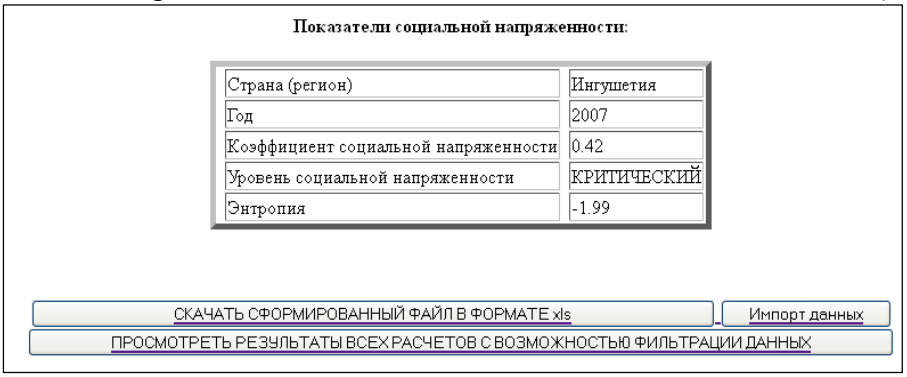

Figure 3 – Result of calculation of social tension indicators

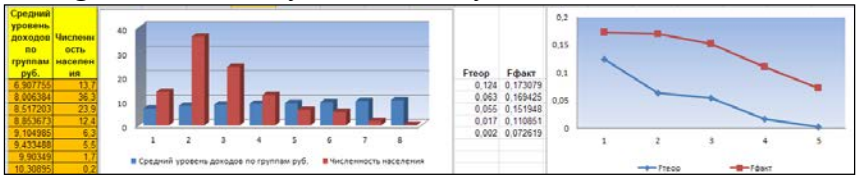

Figure 4 – Visualization result of calculation of social tension indicators

This software allows to analyze tendencies of the social conflicts and in time to develop the measures directed on their prevention. The developed program realization to modeling of social tension level of society in the Russian Federation can be useful to representatives of government institutions (for example, Goskomstat) to performance of calculations and maintaining a database on the received indicators serving security services to preparation of security measures in conflict situations, and also to politicians and the economists who are responsible for decision-making in the sphere of distribution regulation and redistribution of the income of the population, and also other areas of country system. Formation of necessary administrative influences for decrease in social tension on the basis of increase of validity and adequacy of administrative decisions at regional and state levels, promotes increase of stability of society, formation of fair social policy.

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TECHNOLOGY KNOWLEDGE MANAGEMENT IN THE FIELD OF OIL PRODUCTION

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The paper presents the technology of ontological organization of data on oil production and application of results to solve the problem of effective search of scientific information in the indicated direction.

Keywords: ontology, oil production, search, ontological engineering.

Technology development RDF (Resource Description Framework, «Resource Description Framework") on the basis of XML substantially simplifies interaction interests of specialists and integrate specific forms and formats representations of objects and in such subject areas as use of mineral resources, natural language processing information, making decisions, expert systems based on Internet technologies formats. Because knowledge is integral to part of any business process, natural question arises how to use the results of this research in such subject areas, such as oil production.

The theory of ontologies began to be applied in applied sciences rather recently. The main task of the models constructed on the basis of ontologies is the further development of procedures of navigating on information resources. We will consider the main tendencies and perspectives of use of ontologies for information support of processes of oil production.

In informatics the term "ontology" means the formal representation of knowledge. Ontologies are used for fixation of knowledge of any area of interest and define concepts or the concepts relating to selected data domain, and also set the relations between these terms. Ontologies are applied in different areas of representation of the knowledge which is going beyond science of "information scientist". On the Internet in the free access there are the ontologies classifying knowledge of medicine, genetics, besides to the address http://www .opencyc.org, there is the biggest and full knowledge base in the pattern, being ontology of the top level. Ontologies are created in order that different people used common language which allows to reach the general understanding on this or that question.

The modern ontologies may contain tens and hundreds thousands determination therefore they often have the format convenient for reading by the computer, and have strict logical basis. The main objective of creation of ontologies – to achieve the general understanding of terms which will be used for information exchange on the Internet. The ontology describes area concepts, and as correlations in between.

The engineering of ontologies can be defined as set of the actions concerning:

- development process of ontologies;
- life cycle of ontologies;
- methods and methodologies of creation of ontologies;
- tool kit and languages for their creation and support.

We give a simple algorithm ontological engineering :

- defines the terms of the domain and the relationships between them ;
- allocated domain concepts - the basic concepts of the subject area;
- defined " ontology tree height " - the number of levels of abstraction ;

– selected concepts are distributed over the levels .

– built connections between concepts - defined relationships and interactions of basic concepts , attributes and properties of classes (subclass - superclass) , imposed restrictions on their values. Then the definition of individuals or instances imparting values and attributes and properties ;

– consultations with various specialists to eliminate contradictions and inaccuracies.

By development of methodology of structure declaration of concepts in the field of oil production it is necessary to consider that the methodological knowledge has accurately expressed procedural character. All levels of methodology will form difficult system in which there is a taxonomy of methods. Selection of concepts for the specified data domain is the activities directed on search and formation of new knowledge, their structures, entity, the contents and functioning, the principles and technologies of interaction among themselves objects of oil production. Development of ontologies is cyclic process and always begins with processing of elementary sets of concepts of this data domain and the description of how these concepts correspond with each other. The ontology structure, as a rule, consists of two parts: name of important concepts and information or knowledge of this concept. The formal model of ontology is provided in a figure 1.

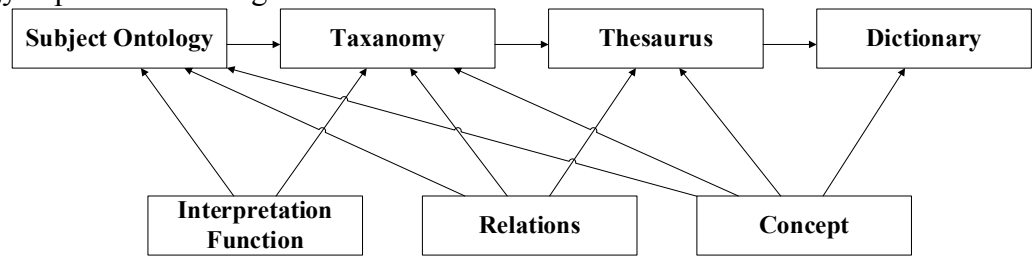

Figure 1 - The formal model of ontology

Integrating the standard operations executed in case of formation of conceptual component ontology [1], with those operations which are dictated by requirements to a linguistic component, it is possible to formulate the list of the actions which are subject to execution by the expert during ontological engineering:

1 . Formation of the conceptual diagram of ontology based on professional knowledge in data domain:

a) Selection basic notions - concepts. For example, investigation of oil is: the search method, carrying out field and cameral operations, are formed cards and diagrams, different types of shootings are carried out, for example, aero magnetic, curve dependences of parameters of deposits are built, the kartirovochnykh of slits, a field oil, year of opening, the oil-and-gas pool, etc. is characterized by depth;

b) Classification of basic concepts with formation of the abstract concepts – class names: object types, their characteristics, c situations their involvement. For example: concepts - object types: the oil field, has the name; concepts - types of object attributes: year of opening, operator of development, inventory of deposits; concepts - types of characteristics of object: has the minimum depth, has the maximum depth; concepts - types of situations (including roles of participants): mastering start date, initial output of slits per day, density of oil, etc. belongs to the list of oil fields of Russia;

c) Determining the possible relations of concepts. For example: oil field-> {describes} -> attribute an oil field -> {contains} -> parameter list> {contains} -> options -> {characterized} -> date of the beginning of development, initial production rate of wells per day, the density of oil-> {is characterized} -> minimum depth of deposits, the maximum depth of the deposit, the operator of the field ->, etc.

2 . Formation of the actual terminological filling of ontology – correlation of all terms of data domain with concepts of the conceptual diagram, during that:

a) expanding vocabulary concepts by building ontology "in depth" if ontology involves subsumption relation (general-> private, part-> integer) between the concepts of a class, for example, a list of parameters of oil -> name of the oil field -> oil and gas pool-> classification of oil fields -> etc.;

b) for each concept the dictionary of possible terms values is created: name of an oil field = {Samotlorsky, Mamontovsky, Romashkinsky, Pashshorsky, Lyantorsky, Fedorovsky, Priobsky, Salymsky …}.

3 . Formation of a linguistic component:

a) synonymous designations of each concept or values (terms) are fixed: N = Oil field, NG = Oil and gas field, GN = Gas-oil field, the Largest = Very big, etc.;

b) methods of expression of the relations from ontology in language – standard lexical and grammatical constructions for what the formalism corresponding to the linguistic analyzer is used are described.

Different languages of ontologies give unequal opportunities. The newest development among standard languages of ontologies is OWL from World Wide Web Consortium (W3C), received practical implementation in the form of the interface in the editor of creation of ontologies of Protege. OWL allows to describe concepts - basic concepts of data domain. In OWL there is a rich set of operators – for example, intersection, combining and denial. The OWL language is based on different logical models which allow to define a concept as it is described. Thus, the composite concept can be gradually created from determination of simpler concepts. Besides, the logical model does possible use of the “reasoner” mechanism which can check, whether all statements and determination in ontology are mutually consistent and also to recognize under what determination concepts approach. Therefore this mechanism can help maintenance of incorrect hierarchy. It is especially useful by operation with the classes having more than one parent.

In the course of creation of ontologies the main idea consists that having the description of some concepts, we can give determination which, finally and will set our concepts [2]. For example, having set look determination: "Geological methods of investigation of oil is a subset of the concept Search and oil production", "Geophysical methods of oil production is a subset of the concept Search and oil production", "By search of oil mapping of geological structures is carried out)", we receive the statement that "In case of Geological or geophysical methods of investigation of oil mapping of geological structures" is carried out. That is any object possessing properties of determination automatically, will be or a geological method of investigation of oil, or a geophysical method of investigation, etc.

Besides, in design process of ontologies it is possible to set properties which don't enter determination, and set properties of more difficult objects. It becomes with the purpose to receive hierarchy of the objects provided to ontologies in the form of determination and properties, and not just in the form of graph structure.

Having designed thus, ontology, it is possible to check result by means of a special purpose tool – “reasoner” and automatically to construct a taxonomy. All given examples and operations, probably to decide with theory uses the descriptive logics.

Descriptive logic - a family of knowledge representation languages that allow the definition of domain concepts in a formalized manner. Family descriptive logics are common logic classes specially designed for modeling ontologies. They are the language of expression on allegations or assertions of what is true. Writing in a formal language allows unambiguous description of ontologies, and allows us to prove their consistency and to handle different requests for them. Such evidence ensure validation and compilation of ontologies allow for evidence on a set of ontologies in terms of consistency of two or more ontologies.

For example, the class "Geological exploration methods" will contain elements which are a way of oil exploration in our domain. Classes can be organized in a hierarchy superclass

- subclass, which is also known as taxonomy. Subclasses specialize ("are part of") its superclass. For example , considering the classes of "Oil Search" and "Geological exploration methods" - "Geological exploration methods" may be a subclass of "Search for Oil" (i.e., "Oil Search" - is a superclass of class "Geological exploration methods"). It stated as follows: "All the geological exploration methods used to search for oil", "All members of the class Geologic exploration methods are members of the class search of oil", "Use geological exploration methods implies search of oil" and "Geological exploration methods is part of the search for oil" . Examples of various constraints (axioms) ontology concepts are shown in Figure 2.

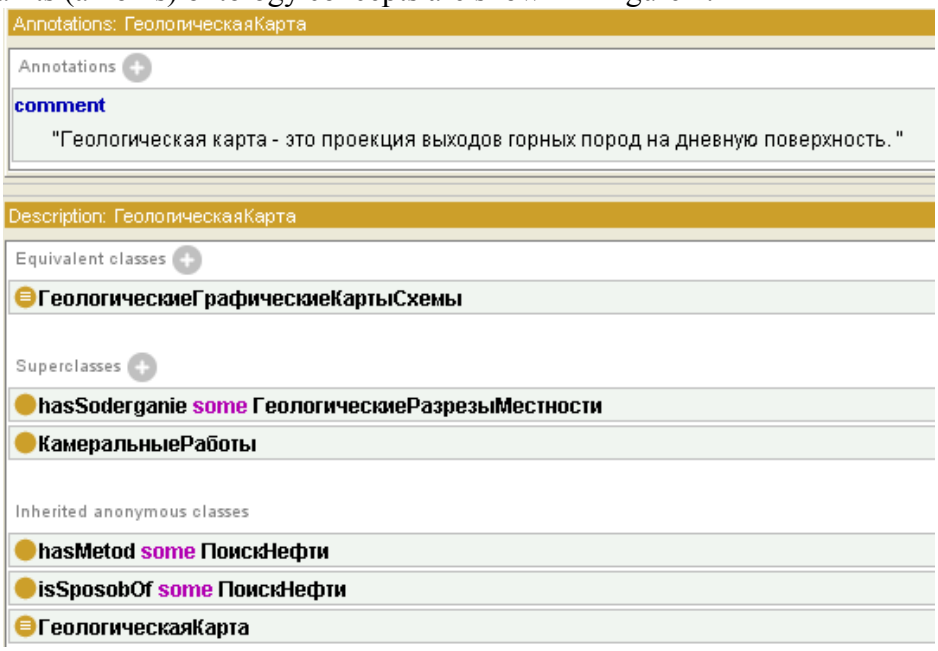

Figure 2 – Examples of different constraints (axioms)

We will review an example of descriptive logic (table 1).

Table 1 Example of Descriptive Logic

Relation of two concepts	The ratio of the instance and the concept	The ratio of the instance and the concept
"Magnetic methods for wells" is "Geophysical Methods of wells"	"Method's natural magnetic field" is "Geophysical Methods of wells"	"Method's natural magnetic field" is "Magnetic methods for wells"

In this example, "Magnetic methods for wells", "Geophysical Methods of wells" are concepts, "Is" - attitude, "Method's natural magnetic field" - instance. Copy of the "Method's natural magnetic field" attitude inherits the parent concept.

Systems descriptive the logician have semantics of "the open world" that allows to specify incomplete knowledge, and the indicative force of language is restricted to a small number of designers for creation of difficult concepts and roles.

Concepts descriptive the logician are tools for recording knowledge of the described domain is subdivided into a general knowledge of the concepts and their relationships and knowledge about individual objects, their properties and relationships with other objects. In accordance with this division recorded with the language descriptive the logician of knowledge are divided into a set of terminological axioms (TBox) and a set of assertions about individuals (ABox). Component TBox introduces the terminology or, in other words, the vocabulary of the field, while the component ABox contains assertions about named representatives (copies) of concepts in terms of vocabulary [3].

The purpose of language development is the ability to formulate and publish a Web network ontology - a formal written approval of the concepts and objects of a domain and automated inference of new knowledge based on existing. Considered in Table 1 for an example of OWL language will look like:

<owl:Class rdf:ID=" wells *"/>*
<owl:Class rdf:ID=" Geophysical Methods of wells ">
<rdfs:subClassOf rdf:resource="# wells "/>
</owl:Class>
<owl:Class rdf:ID=" Magnetic methods for wells ">
<owl:Restriction>
<owl:onProperty rdf:resource="#is"/>
<owl:hasValue rdf:resource="# Geophysical Methods of wells "/>
</owl:Restriction>
</owl:Class>
<owl:Thing rdf:ID=" Method's natural magnetic field ">
<rdfs:type rdf:resource="# Geophysical Methods of wells"/>
</owl:Thing>

As all concepts: methods of search of oil, research of slits, methods of oil production are connected by a set of direct and back couplings, and shall make the uniform, transparent, well-structured system, creation and application of ontologies becomes the mechanism integrating a huge number of existing information in a single system, a basis for orientation in data domain of subsurface use on the example of oil production [4]. The fragment of the constructed ontology for methods of search of oil is given in a figure 3.

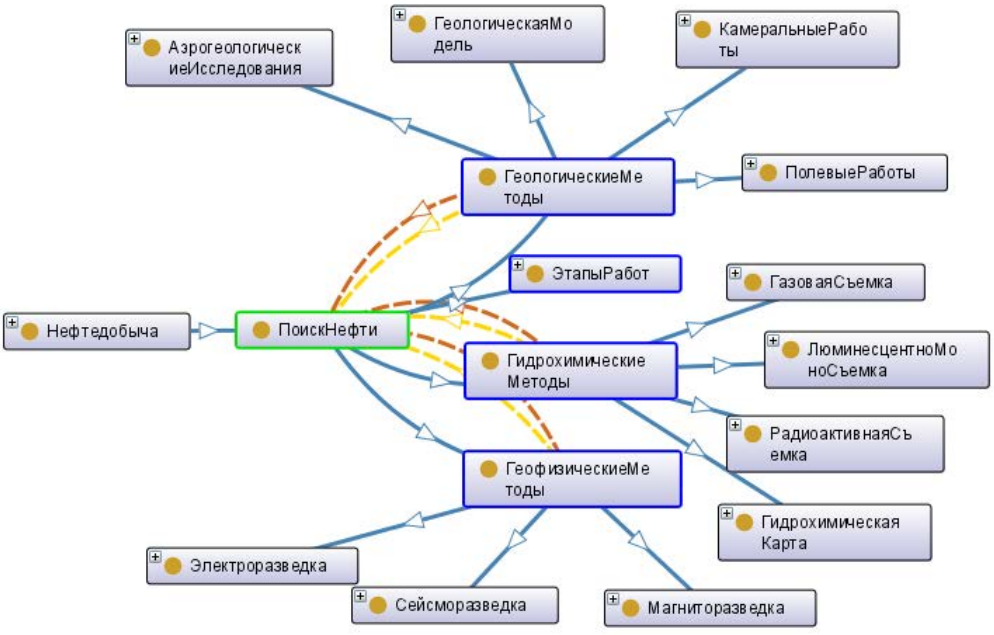

Figure 3 - The ontological graph for methods of search of oil

Application descriptive the logician will give the chance to implement programmatically operation with formally described ontologies of knowledge domains, to control ontologies by display of concepts and the ontology relations in statements of logic, and the knowledge bases created thus can be used for request processing. Since ontology creation on the example of oil production, further, the similar knowledge base can become a reference point in case of creation of knowledge in data domain subsurface use, and for interested persons – essentially new, from the point of view of the opportunities, information source.

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THE OIL PROCESSING DEVELOPMENT IN RUSSIA ON THE BASIS OF CORPORATE FORSYTHE'S TECHNOLOGY

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The main components of technology of corporate Forsythe and the main technological tendencies of improvement of quality of oil products for oil processing development in Russia are considered.

Keywords: fuel and energy complex, technologies, corporate Forsythe, marketing, quality of oil products.

The fuel and energy complex is fundamentals of the Russian economy. In this branch nearly 2 million people work, creating about 30% of gross domestic product of the country. Russia takes leading places in the world on oil and gas production volumes, in the sphere of coal mining and in power industry enters the five of the first countries [1].

Investments into fuel and energy complex reach 2,7 trillion rubles a year. It is very important that the energy industry is focused not only on ensuring internal requirements of economy, but also is export-oriented branch (provides 50% of receipts in the budget of the country and nearly 70% of export). Actually, the energy industry is the driver of the Russian economy with which are connected, including, and plans for large-scale modernization and development of competitiveness of our country.

Now the considerable share in export is made by low-quality oil products [2]. Russia considerably lags behind in the development of technologies of oil processing and petrochemistry, first of all because of the weak introduction of innovations in oil branch, however in the country there is necessary scientific development for the more effective oil refining.

The Ministry of Energy of the Russian Federation approved the Development plan gazo- and petrochemistry till 2030 according to which the branch will be able to make a qualitative jump forward. The development of capacities of domestic oil and gas chemistry is supposed to be carried out within the Volga, West Siberian, Caspian, East Siberian, Far East and Northwest clusters which are near sources of raw materials and sales markets. According to the plan concerning hydrocarbons, it is expected that more than a half of all easy hydrocarbonic raw materials it will be directed on deep processing — in the further petrochemical repartitions, being characterized by higher value added.

The corporate Forsythe's technology in the solution of problems of oil processing.

Number of the most important problems of modernization of oil processing and petrochemistry of Russia treat: transition from trade in crude oil to trade in oil products and petrochemistry products; technical regulations commissioning on new standards of oil products; reconstruction operating and construction of new fuels of installations improving quality, alignment of duties on light and dark oil products; radical modernization of the operating enterprises with increase in depth and complexity of processing of raw materials; construction of new export-oriented oil and petrochemical refineries; system construction for transportation of hydrocarbonic raw materials and processing products; development of domestic technologies of processing of gas and oil raw materials. Other important aspect of modernization is oil refining deepening.

For the solution of these tasks it is necessary to attract corporate Forsythe's technology – inclusion in a problem of versatile participating subjects (experts, the companies, universities, sociological and political institutes of governmental level) for the analysis of development of the future of oil products in the next and long-term prospects (15 – 30 years), development of a road map of a solution [4,5].

However, it is originally necessary to carry out the deep analysis of the different parties of object of research: marketing and tendencies of development of the market of oil products, the accounting of strategy of the competition in oil business, research of the main technological tendencies of improvement of quality of oil products, adjust opinions of consumers, the accounting of a position of the government, selection of breakthrough technologies of the improvement of quality of oil products.

The marketing of the market of oil products [6].

Innovations in oil processing and petrochemistry — it is the pledge of the existence and a the branch survival in the next 10 — 15 years. For the successful realization of the innovative policy and the implementation of the program of strategic development of branch till 2020 it is necessary to carry out large projects of modernization of the enterprises in the shortest terms. Important task also is increase of a share of the domestic equipment in projects of modernization of the Russian oil processing since now at construction new and modernizations of operating productions the most part of the equipment is delivered from abroad.

The improvement of the quality of oil products and its finishing to ecologically reasonable standards – one of the most important conditions of removal of oil processing branch on the modern technological level, which achievement will provide needs of the country for qualitative motor fuel, lubricant oils, raw materials for petrochemistry and other oil products.

The increase of requirements to the quality of oil products and modernization of the enterprises of the oil processing will provide the improvement of an ecological situation, decrease in specific power expenses at production.

The petrochemical and chemical industry of Russia the last 10 years develop high rates. Programs of the strategic development of branch in the Volga federal district, in the Republic of Tatarstan are prepared and approved as Strategy of development of the chemical and petrochemical industry of Russia till 2015. In a number of the large chemical and petrochemical companies are developed and development strategy which cause the chemistry and petrochemistry development, conducting to the development of the chemical industry as a whole are realized. In branch tens investment projects are realized.

Nevertheless, the chemical industry and a petrochemical complex of Russia has obvious deficiency in high-quality researches of the market of chemical production. The lack of the reliable information, absence of universal standards lead to that only the insignificant part of projects reaches financing and realization.

At all options of the development, except critical, the growth of volumes of oil refining is expected: by 2020 it can reach 190 - 215 million tons/year with the simultaneous increase in the depth of the processing to 80 - 85% by 2020.

At the critical option of the development the volume of oil refining will decrease and can make in 2020 a little more than 170 million tons.

The main technological tendencies of the quality improvement of oil products [8].

To refiners easy grades of oil, for example are the most attractive: BrentBlend with the content of sulfur no more than 0,37%, the Russian grade of light SiberianLight oil – 0,57%, the export mix ESPO – 0,53%. These are the most expensive and demanded grades. The difference in the price for ton of high-sulphurous and low-sulphurous fuel oil makes 20-30 US dollars.

Sulfur is the most harmful component of a gasoline, but it removal from fuel isn't favorable to processors. As a result only gasoline of the A-95-Evro brand has the European level of quality and conforms to EBPO-4 requirements (according to these requirements the content of sulfur shouldn't exceed 0,015%). In turn the most rigid standard of EBPO-5 which is entered in the European Union since 2008 and is obligatory to application for all types of fuel, demands that the content of sulfur didn't exceed 0,001% or 10 mg/kg.

Today domestic A-95 hardly holds out to the EBPO-3 standard, when import A-95-Evro both more qualitatively, and more expensively. But if in Europe use of less qualitative gasoline in connection with rigid environmental standards is forbidden, in the Russian Federation such rigid restrictions aren't present because gasoline is a priori lower on quality. It is also necessary to consider that depends and directly on got raw materials much: in the Russian Federation heavy oil in a type of existence of large-scale deposits of the high-sulphurous oil demanding additional processing for achievement of export quality is on the average extracted. The main objective of the Russian government in this regard is the development of accurate strategy of permission of current situation taking into account competitive advantages of the Russian resource base, stimulation of development of hardly removable fields of high-quality oil in Eastern Siberia and in the Far East, and also alignment of the quality standards of the Russian mix Urals in relation to North Sea BrentCrude oil.

It should be noted that technologies of the improvement of the quality of oil products are inseparably linked with technologies of their control. So, the chair Information technologies of Moscow State University of technologies and management named K.G. Razumovsky together with scientists of the Russian Academy of Sciences and the Russian company "Intelkomtekh" developed new perspective technologies of an operating control of quality of light oil products (the instant determination of octane numbers, a number of indicators of quality, the content of sulfur, benzene) [8, 9]. However their introduction also demands application of methods of Forsythe.

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RUSSIAN CREDIT RATE AND ARBITRAGE THEORY

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We assumed that the credit rates for any period are subject to the same laws as the yield to maturity zero-coupon bonds for the same period. For bonds in a time-discrete model there is a known affine temporal structure of yield to maturity that depends on the current short-term rate, i.e., the yield to maturity for one-period bonds. These facts allowed us to construct the temporal structure of lending rate on the Moscow market of interbank credits.

Keywords: lending rates, yield to maturity, arbitrage-free principle, stochastic discount factor

In the theory and practice of asset pricing, the main approach is based on the assumption that it is arbitrage-free, i.e., on the *arbitrage-free principle* (AFP) [1]-[3]. This means that two portfolios with equal future random payments (*equivalent* portfolios) must have the same current price. Otherwise, arbitrage becomes possible (i.e., it is possible to earn a «free breakfast»), namely, the owner of the portfolio with a higher price can sell it and buy an equivalent portfolio with a lower price and thus obtain an income equal to the difference between the prices, because the expected future payments in both portfolios are the same. According to the AFP, the price of the financial portfolio is determined as the price of the equivalent portfolio with simplest assets whose prices can easily be calculated.

It is important to note that the AFP is based only on the information about the relations existing between different financial assets but says nothing about the process of origination of these prices.

In the present paper, we follow Cochrane's approach [4] whose main idea is that the determining factor of pricing (its kernel) is the *stochastic discount factor*. But, in contrast to [4], we pay the main attention to the term structure and pricing of interest rates in the framework of the so-called Duffie-Kan affine models [5] with discrete time. This allows you to find temporary structure yield to maturity zero-coupon bonds if you use a discrete Vasicek model for the short-term rate [6]-[7]. In this structure, there is one free parameter, hereinafter referred to as latency. These issues are discussed in the first section of this paper.

In the second section, we discuss the relationship between the observable variables of this model and the latent variable characterizing the investor attitude to the risks due to variations in the stochastic discount factor.

Further the relations obtained for the yield to maturity of zero-coupon bonds are used for the interest rates on the Russian credit market. Obviously, the yield to maturity of one-period bonds in a discrete time model looks like the lending rate for the same period. We assumed that interest rates for any period are subject to the same laws as the yield to maturity zero-coupon bonds for the same period. Strictly speaking, this is only a hypothesis about *the equivalence of temporary structures of credit rates and yield to maturity*. In reality, bonds and loans are not

the same so as the loans cannot generally be sold before the deadline, unlike the bonds traded on the secondary market.

In the third section, it was shown how the model in question can be used to analyze the lending rates on the Moscow market of interbank credits (MMIBC, «MosPrime»). The data for these rates are presented in Appendix 1. Five figures show that using a single latent variable as the "gauge parameter", we can achieve a good agreement between the calculated yield of loans (deposits) and the observed rates. Note that only a single value of "gauge parameter" was used for five different credit durations at a time.

Remark. In the case of continuous models, the econometric estimation of interest rates was performed in 2003 on the basis of the MMIBC data by Anatoliev and Korepanov [8]. Bjork's monograph [9] contains a detailed survey of the last achievements in the field of continuous time models. A rather complete econometric investigation of statistical properties of GKO maturing yield was performed by Drobyshevskii [10].

1. Construction of a pricing model

We consider a pricing model on the zero-coupon market based on the following hypotheses and theorems.

Proposition 1. For any t, the logarithm of the price of one-period bond is given by the formula

$$\ln b_t^1 = -r_t, \quad \ln b_{t+1}^1 = -r_{t+1}, \tag{1.1}$$

where r_t is the so-called short-term rate whose dynamics is described by the following hypothesis.

Proposition 2. The short-term rate varies in discrete time by the formula

$$r_{t+1} = \varphi \cdot r_t + \theta \cdot (1-\varphi) + [w_0]^{1/2} \cdot \varepsilon_{t+1}, \tag{1.2}$$

where $w_0 \geq 0$, and all ε_{t+1} are independent identically distributed variables for distinct t and $\varepsilon_{t+1} \in N(0,1)$. In financial mathematics, Eq. (1.2) is called the Vasicek discrete model [6], but in the physical literature it is usually called the Ornstein-Uhlenbeck discrete model [11]-[13].

Proposition 3. The condition that the bond market is one-period arbitrage-free is satisfied if the prices of an n-period bond at time t are determined by the conditional mathematical expectation of the discounted price of an $n-1$-period bond at time $t=1$, i.e.,

$$b_t^n = E_t\{m_{t+1} \cdot b_{t+1}^{n-1}\}, \quad b_t^0 = 1 \quad \forall t. \tag{1.3}$$

Here $E_t\{...\}$ means averaging over a measure related to the realization ε_{t+1}, and m_{t+1} is a stochastic discount factor depending on ε_{t+1}.

Proposition 4. The stochastic discount factor is determined by the short-term rate r_t, the random variable ε_{t+1}, and two constants δ and λ by the formula

$$-\ln m_{t+1} = \delta + \gamma \cdot r_t + \lambda \cdot [w_0]^{1/2} \varepsilon_{t+1} \quad . \tag{1.4}$$

Proposition 4 implies the following obvious corollary.

Corollary 1. The random variable m_{t+1} has a log-normal conditional distribution

$$\ln m_{t+1} \in N(-\delta - \gamma \cdot r_t, \quad \lambda^2 \cdot w_0), \tag{1.5}$$

and hence direct calculations easily prove that the logarithm of the mean is determined by the logarithm mean plus haft the logarithm variance:

$$\ln E_t\{m_{t+1}\} = E_t\{\ln m_{t+1}\} + \frac{1}{2}\cdot D\{\ln m_{t+1}\} = -\delta - \gamma\cdot r_t + \frac{\lambda^2}{2}\cdot w_0 . \quad (1.6)$$

Corollary 2. Since Proposition 3 and Corollary 1 imply

$$\ln b_t^1 = \ln E_t\{m_{t+1}\cdot b_{t+1}^0\} = \ln E_t\{m_{t+1}\cdot 1\} = -\delta - \gamma\cdot r_t + \frac{\lambda^2}{2}\cdot w_0 ,$$

the following relation between the constants is required for the consistency with Proposition 2:

$$\delta = 0{,}5\lambda^2\cdot w_0 , \quad \gamma = 1 \quad . \quad (1.7)$$

Corollary 3.

$$\ln b_t^2 = \ln E_t\{m_{t+1}\cdot b_{t+1}^1\} = \ln E_t\{\exp(-\delta - \gamma\cdot r_t - \lambda\cdot[w_0]^{1/2}\cdot\varepsilon_{t+1} - r_{t+1})\} =$$

$$= 0{,}5\cdot(\lambda+1)^2\cdot w_0 - (\delta + \theta\cdot(1-\varphi)) - (\gamma+\varphi)\cdot r_t$$

or with Corollary 2 taken into account,

$$\ln b_t^2 = -\theta\cdot(1-\varphi) + (\lambda + \frac{1}{2})\cdot w_0 - (1+\varphi)\cdot r_t \quad (1.8)$$

Theorem. If the assumptions of Propositions 1-4 are satisfied, then the price of an n-period bond b_t^n depends on the time t only through the value of the short-term rate r_t:

$$-\ln b_t^n = A_n + B_n\cdot r_t , \quad (1.9)$$

and the coefficients A_n, B_n are independent of time.

These coefficients satisfy the system of recursive equations

$$A_{n+1} = A_n + [\theta\cdot(1-\varphi) - w_0\cdot\lambda]\cdot B_n - 0{,}5w_0\cdot B_n{}^2 ,$$

$$B_{n+1} = 1 + \varphi\cdot B_n , \quad (1.10)$$

$$A_0 = A_1 = 0, \quad B_0 = 0, \quad B_1 = 1.$$

This theorem is proved by the method of mathematical induction on n. By formula (1.8), assertions (1.9)-(1.10) hold for $n = 0$ и $n = 1$. We assume that they hold for n and prove them for $n+1$. By Proposition 3 stating that the bond pricing is arbitrage-free, we have

$$\ln b_t^{n+1} = \ln E_t\{m_{t+1}\cdot b_{t+1}^n\} =$$

$$= \ln E_t\{\exp(-0{,}5\lambda^2\cdot w_0 - r_t - \lambda\cdot[w_0]^{1/2}\cdot\varepsilon_{t+1} - A_n - B_n\cdot r_{t+1})\} =$$

$$= -[A_n + B_n\cdot(\theta\cdot(1-\varphi) - \lambda\cdot w_0) - 0{,}5w_0\cdot B_n{}^2] - [1+\varphi\cdot B_n]\cdot r_t = -A_{n+1} - B_{n+1}\cdot r_t .$$

Comparison of the last two rows shows that recursive relations (1.10) are satisfied. □

For a short-term rate r_t whose dynamics is modelled by Eq. (1.2), we have the following relations for the conditional means and variances of the variable r_{t+n}:

$$E_t\{r_{t+n}\} = \varphi^n\cdot r_t + \theta\cdot(1-\varphi^n) \quad (1.11)$$

$$D_t\{r_{t+n}\} = w_0\cdot\Psi_n{}^{(0)} \quad (1.12)$$

where the coefficients $\Psi_n{}^{(0)}$ are determined by the relations

$$\Psi_j{}^{(0)} = \sum_{k=0}^{j-1}\varphi^{2k} = \frac{1-\varphi^{2j}}{1-\varphi^2}. \quad (1.13)$$

Formulas (1.11)-(1.13) are proved by the method of mathematical induction.

In relations (1.9), (1.10) determining the arbitrage-free prices of the bonds, all variables except the constant λ are determined by Eq. (1.2) for the short-term rate, which is quite natural. The constant λ first appeared in the stochastic discounting coefficient (1.4). With (1.7) taken into account, the logarithm of this coefficient is determined by the formula

$$-\ln m_{t+1} = r_t + \frac{\lambda^2}{2} \cdot w_0 + \lambda \cdot [w_0]^{1/2} \varepsilon_{t+1} \quad . \tag{1.14}$$

Formula (1.14) means that the constant λ together with the conditional variance $D_t\{r_{t+1}\} = w_0$ and the random variable ε_{t+1} determine the stochastic discounting coefficient m_{t+1} deviation from the «natural» quantity $E_t\{m_{t+1}\} = \exp(-r_t)$ depending only on the short-term rate r_t.

It follows from formulas (1.2) and (1.14) that $COV_t\{\ln m_{t+1}, r_{t+1}\} = -\lambda \cdot w_0$, and hence

$$corr_t\{\ln m_{t+1}, r_{t+1}\} = -\lambda \cdot |\lambda|^{-1}. \tag{1.15}$$

In other words, the modulus of the logarithm of the correlation of stochastic discount factor and the short rate is equal to one, and the sign is determined by the sign of the constant λ.

2. Observable variables and a latent parameter λ

To test the hypothesis of the equivalence of temporary structures stated in the introduction, let us consider the temporal structure of zero-coupon bonds yield to maturity, following this model of pricing bonds.

It follows from the meaning of continuous rates used in the present paper that the maturing yield of an n-period bond at time t is given by the formula

$$y_t^n = -\frac{1}{n} \cdot \ln b_t^n \quad . \tag{2.1}$$

In the proposed model of arbitrage-free pricing (1.9), the yield is determined by the formula

$$Y_t^n = -\frac{1}{n} \cdot \ln b_t^n = \frac{A_n + B_n \cdot r_t}{n} \quad . \tag{2.2}$$

where A_n, B_n are determined by the recursive relations (1.10).

In formulas (1.10), all values except constants λ have a very definite economic meaning as a defined econometric model of the short-term rate (1.2).

In the general initial model, the parameter λ first appeares in (1.4) and determines the value of the linear influence of the random factor ε_{t+1} on $\ln m_{t+1}$. For $\lambda = 0$, the stochastic discounting factor (1.4) has the form $m_{t+1} = \exp(-r_t)$; in this case, the discounting at time t of the future price at time $t+1$ depends only on the current short-term rate r_t without taking account of its possible variations under the action of the random factor ε_{t+1}. By formula (1.15), the correlation factor between $\ln m_{t+1}$ and r_{t+1} is equal to $sign(-\lambda)$, and hence it is equal to one for all negative values of λ. Since this parameter does not belong to directly observable

(measurable) variables, it will be called a *latent parameter* of the model under study which characterizes the ***investor attitude*** (or, as is usually said, the bond market) ***to the risk of variation in the short-term rate in the future period.*** The meaning of the latent parameter manifests itself most clearly in the formula of the forward short-term rate $f_t^1(n, n+1)$ connecting the prices of n - and $(n+1)$ - period zero-coupon bonds at time t

$$f_t^1(n, n+1) = \ln b_t^n - \ln b_t^{n+1} . \qquad (2.3)$$

To form a notion such as the forward short-term (one-period) rate $f_t^1(n, n+1)$ in terms of n periods, we consider the hypothetic buying and selling of n - and $(n+1)$-period zero-coupon bonds at time t. We divide the entire procedure into three steps.

Step 1. We sell an n-period bond at time t at the price b_t^n and buy several $(n+1)$-period bonds at the price b_t^{n+1} in the amount of $b_t^n \cdot \left(b_t^{n+1}\right)^{-1}$.

Step 2. We pay a money unit at time $t+n$ for an n-period bond.

Step 3. At time $t+n+1$, we obtain an income in the amount of $b_t^n \cdot \left(b_t^{n+1}\right)^{-1}$ money units for the bought $(n+1)$-period bonds. Thus, we have spent one money unit at time $t+n$ and obtained $b_t^n \cdot \left(b_t^{n+1}\right)^{-1}$ money units at time $t+n+1$. This operation can be associated with the one-period yield $f_t^1(n, n+1)$ starting from the relation $1 \cdot \exp[f_t^1(n, n+1)] = b_t^n \cdot \left(b_t^{n+1}\right)^{-1}$ which implies formula (2.3).

According to (1.2)-(1.5), in the considered model of arbitrage-free pricing, the value of short-term forward rate can be represented as

$$f_t^1(n, n+1) = r_t + B_n \cdot (\theta - r_t) \cdot (1-\varphi) - w_0 \cdot B_n \cdot [\lambda + 0{,}5 \cdot B_n]. \qquad (2.4)$$

The role of the parameter λ in the initial model is completely clarified precisely if we write down (2.4) in the form

$$f_t^1(n, n+1) = E_t\{r_{t+n}\} - w_0 \cdot (1-\varphi^n) \cdot (1-\varphi)^{-1} \cdot [\lambda + 2^{-1}(1-\varphi^n) \cdot (1-\varphi)^{-1}] \qquad (2.5)$$

The first term in (2.5) has the form of conditional mathematical expectation for the short-term rate over n periods and the second term can naturally be interpreted as the risk premium for the one-period rate over n periods. An analysis of formula (2.5) shows that the risk premium is positive for $\lambda < -[2 \cdot (1-\varphi)]^{-1}$ and the asymptotics of the short-term forward rate over a large number n of periods is greater than the average current short-term rate θ.

In this case, if $\lambda < -(1-\varphi)^{-1}$, then the difference $f_t^1(n, n+1) - E_t\{r_{t+n}\}$ is proportional to $w_0 = D_t\{r_{t+1}\}$ and **monotonically** increases with n.

The current maturing yield of an n-period bond (2.2) in the model under study is given by the formula:

$$Y_t^n = \frac{A_n + B_n \cdot r_t}{n} = (\theta - w_0 \cdot (1-\varphi)^{-1}(\lambda + 2^{-1} \cdot (1-\varphi)^{-1})) +$$
$$+(r_t - \theta + \frac{w_0}{1-\varphi}(\lambda + \frac{1}{(1-\varphi)})) \cdot \frac{B_n}{n} - \frac{w_0}{2 \cdot (1-\varphi)^2} \cdot \frac{1-\varphi^{2n}}{(1-\varphi^2) \cdot n}. \qquad (2.6)$$

The quantity Y_t^n monotonically increases with n in the range of the parameters

$$\theta - r_t > w_0 \cdot (1-\varphi)^{-1} \cdot (\lambda + (1-\varphi)^{-1}) \qquad (2.7)$$

In this inequality, all parameters of the model except r_t are constants, but r_t is a time dependent variable. If the investors determine the risk parameter by the inequality $\lambda < -(1-\varphi)^{-1} - w_0^{-1} \cdot (1-\varphi) \cdot (\max\limits_t r_t - \theta)$, then this results in the monotone **increase in the maturing yield** of zero-coupon bonds in time not only for the mean yields $E\{Y_t^n\}$ but also for the current yields Y_t^n.

The preceding analysis of the influence of the latent risk parameter λ only allowed one to obtain several estimates from above in the situations that are often met on the market. Since in the model under study, the parameter λ is determined by investors, it can be interpreted as an adjustable parameter for matching the calculated arbitrage-free and actually observable yields of zero-coupon bonds for all maturity dates.

This program can easily be realized in our model. We consider the goal function $\Phi(\lambda)$ for adjusting the latent variable λ to the observed yield data y_t^n:

$$\Phi(\lambda) = \sum_{n=1}^{N}\sum_{t=1}^{T}(Y_t^n - y_t^n)^2 = \sum_{n=1}^{N}\sum_{t=1}^{T}(\frac{A_n + B_n \cdot r_t}{n} - y_t^n)^2 \quad . \qquad (2.8)$$

Since Y_t^n is a linear function of the latent parameter λ, the function $\Phi(\lambda)$ is a positive definite quadratic function of λ whose minimal value is attained at $\lambda = \lambda^*$:

$$\lambda^* = \frac{1-\varphi}{w_0} \cdot (\theta - \frac{1}{T} \cdot \sum_{t=1}^{T} r_t) -$$
$$-\frac{1-\varphi}{w_0} \cdot (\sum_{n=1}^{N}(1-\frac{B_n}{n}) \cdot \frac{1}{T} \cdot \sum_{t=1}^{T}(y_t^n - r_t)) \cdot (\sum_{n=1}^{N}(1-\frac{B_n}{n})^2)^{-1} - \qquad (2.9)$$
$$-\frac{1}{2 \cdot (1-\varphi)} \cdot \left(1 - (\sum_{n=1}^{N}(1-\frac{B_n}{n}) \cdot (\frac{B_n}{n} - \frac{BB_n}{n})) \cdot (\sum_{n=1}^{N}(1-\frac{B_n}{n})^2)^{-1}\right)$$

(here we use the notation: $BB_n = (1-\varphi^{2n}) \cdot (1-\varphi^2)^{-1}$).

3. Analysis of «MosPrime» credit rates

As a data example, we consider the credit rates of the Moscow Market of Interbank Credits, MosPrime. The MosPrime Rate, i.e., the Moscow Prime Offered Rate, is the indicative rate of rouble credits (deposits) on the Moscow money market.

This indicator is formed by the National Currency Association (NCA) on the basis of the deposit rates of «overnight» terms of 1 week, 2 weeks, and 1, 2, 3, 6 months announced by 8 banks which are the leading operators on the Interbank Credit Market. In our notation, the symbols w1, w2, m1, m2, m3, and m6 denote the deposit rates in percents per annum for 1 week, 2 weeks, 1 month, 2 months, 3 months, and 6 months, respectively. All data are taken from the site http://www.nva.ru and are presented in Appendix 1.

A credit contract on the interbank market can be considered as a zero-coupon bond, because it is standardized with respect to its volume and terms. These contracts are quoted according to their credit rates, but these quotations can easily be converted to the bond prices by using the price-rate dependence.

We chose the weekly rate as a short-term rate. When choosing a week as the shortest duration, it is necessary that all of other durations were divisible by this shortest duration. For uniform harmonization of such requirements, the year was divided into 48 weeks, a month, into 4 weeks. The following initial data were used to construct the observable yields y_t^n:

$$y_t^1 = \ln(1+\frac{w1_t}{a}),\ y_t^2 = \frac{1}{2}\ln(1+\frac{2\cdot w2_t}{a}),\ y_t^4 = \frac{1}{4}\ln(1+\frac{4\cdot m1_t}{a}),\ a = 4800$$

$$y_t^8 = \frac{1}{8}\ln(1+\frac{8\cdot m2_t}{a}),\ y_t^{12} = \frac{1}{12}\ln(1+\frac{12\cdot m3_t}{a}),\ y_t^{24} = \frac{1}{24}\ln(1+\frac{24\cdot m6_t}{a}).$$

For a short-term rate r_t used to construct regression (2.2), we naturally take y_t^1. Table 1 presents the results of the regression construction.

Table 1

Notation	Estimate	T statistics	p-level
φ	0,8284	23,7	0
$\theta\cdot(1-\varphi)$	$1{,}117*10^{-4}$	4,44	$6*10^{-5}$
θ	$6{,}513*10^{-4}$		
w_0	$8{,}612*10^{-10}$		

For 46 observations, $R^2 = 0{,}927$, the White test does not disprove the variance homogeneity hypothesis and the t-statistic of the unit root for the equality $\varphi = 1$ is equal to minus 4,91, while the critical Dickey-Fuller statistic at the 5% significance level is equal to minus 2,93 for our model. The calculated optimal value for latent variable is $\lambda^* = -71213{,}5$; the value of the goal function is $\Phi(\lambda^*) = 9{,}66\cdot 10^{-7}$. For comparison, the value of the corresponding «discrepancy» obtained in the construction of regression (2.2) is equal to $5{,}22\cdot 10^{-7}$, and calculated for five yields, it is only twice greater than the «discrepancy» for one short-term rate, which is a rather good result.

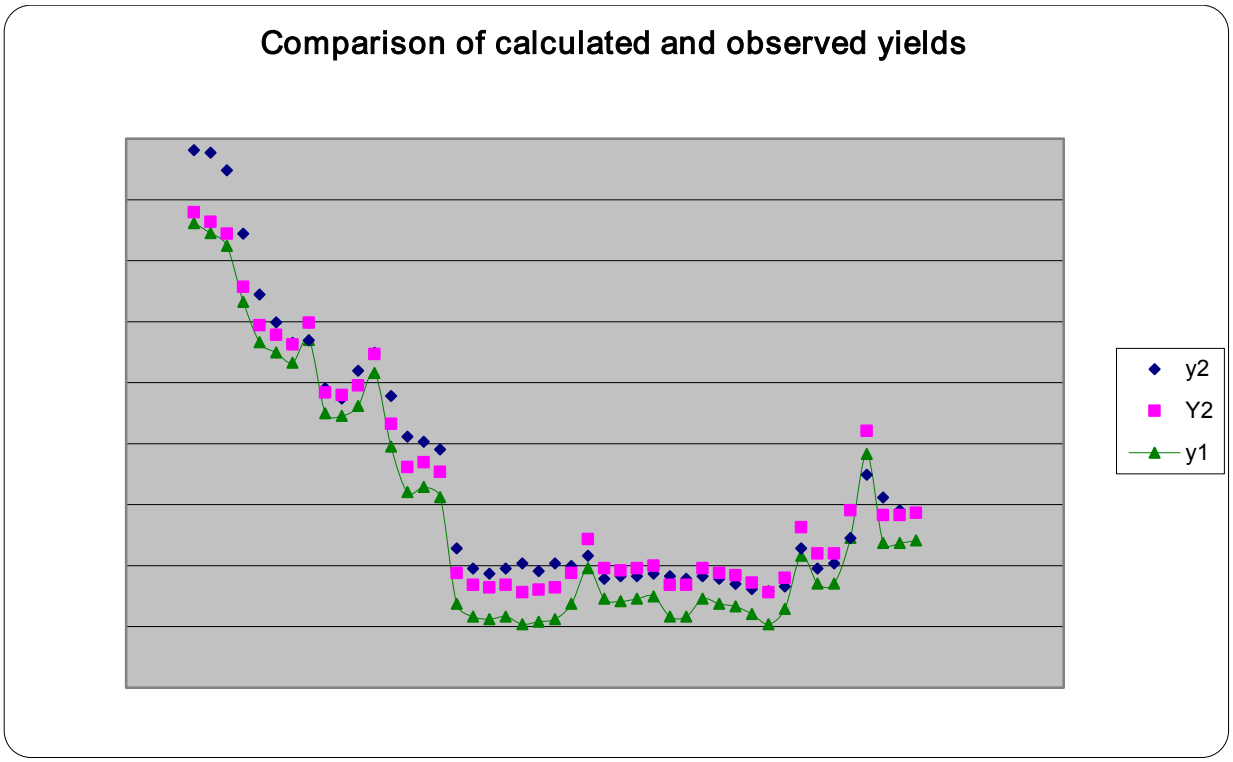

Fig.1. Calculated (Y2) and observed (y2 and y1) yields.

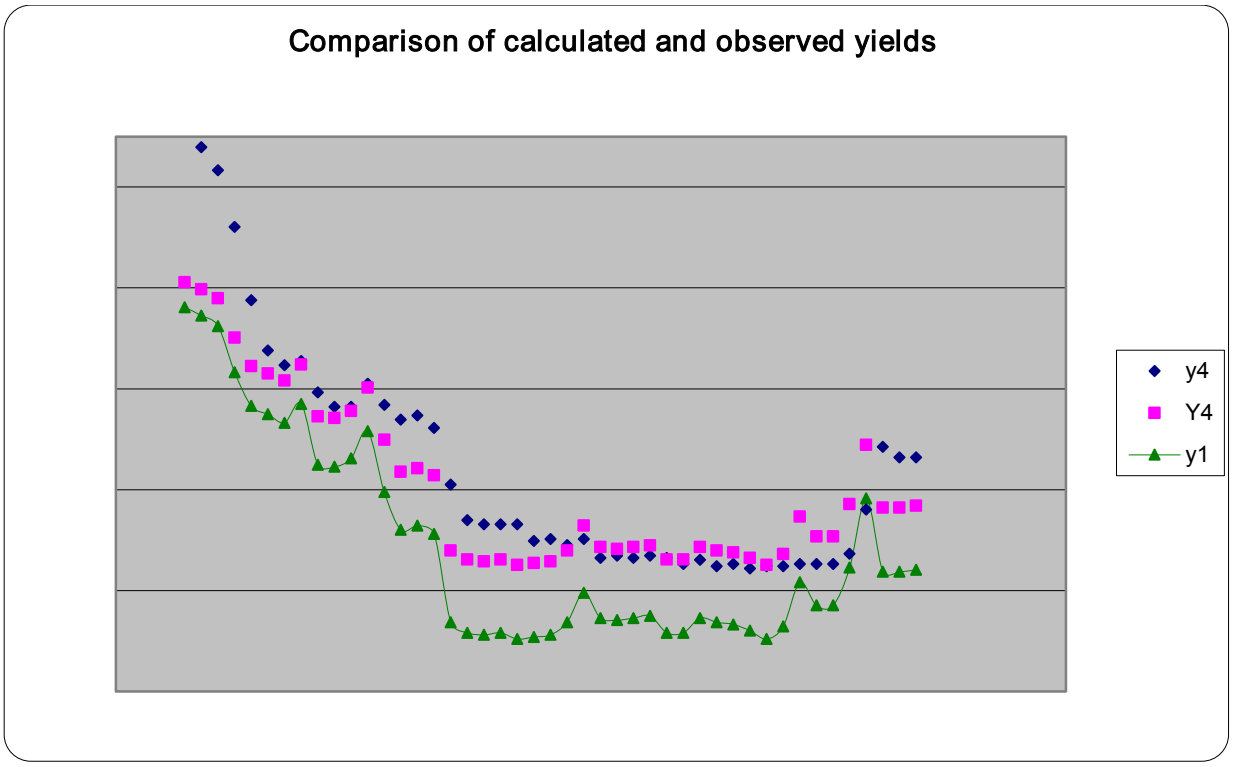

Fig. 2. Calculated (Y4) and observed (y4 and y1) yields.

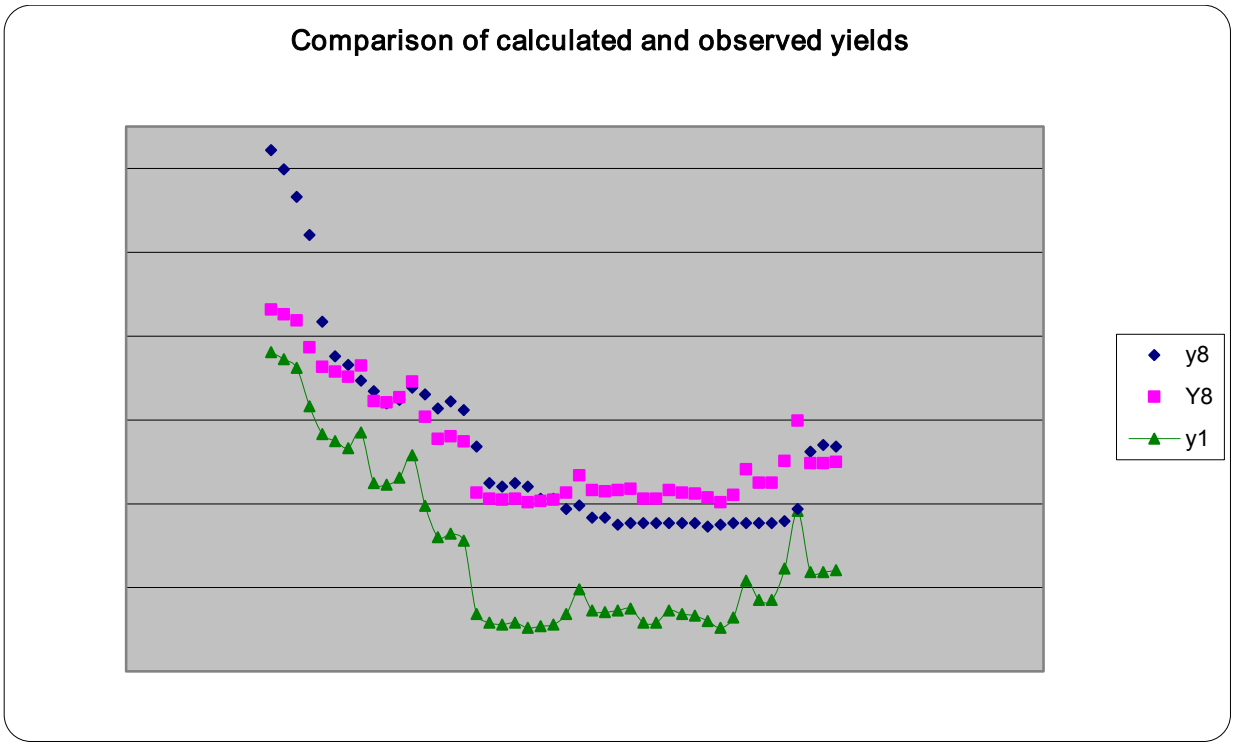

Fig. 3. Calculated (Y8) and observed (y8 and y1) yields.

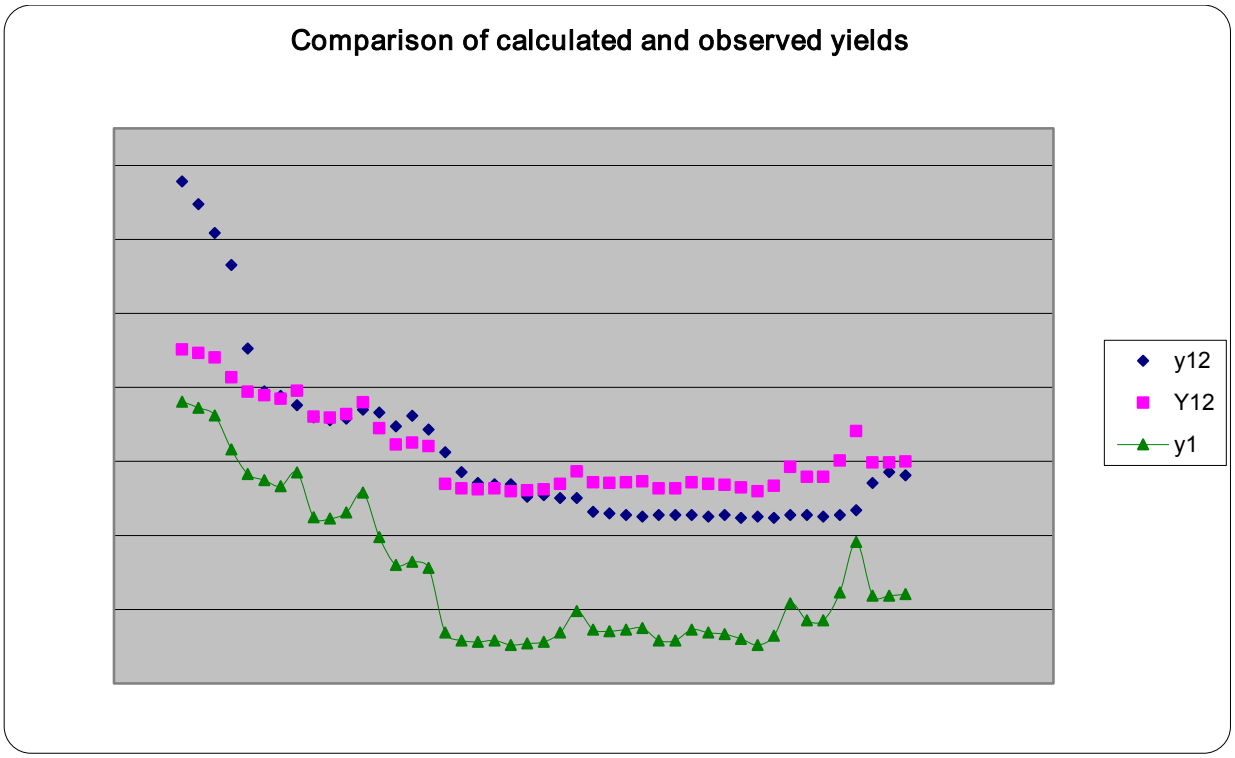

Fig 4. Calculated (Y12) and observed (y12 and y1) yields.

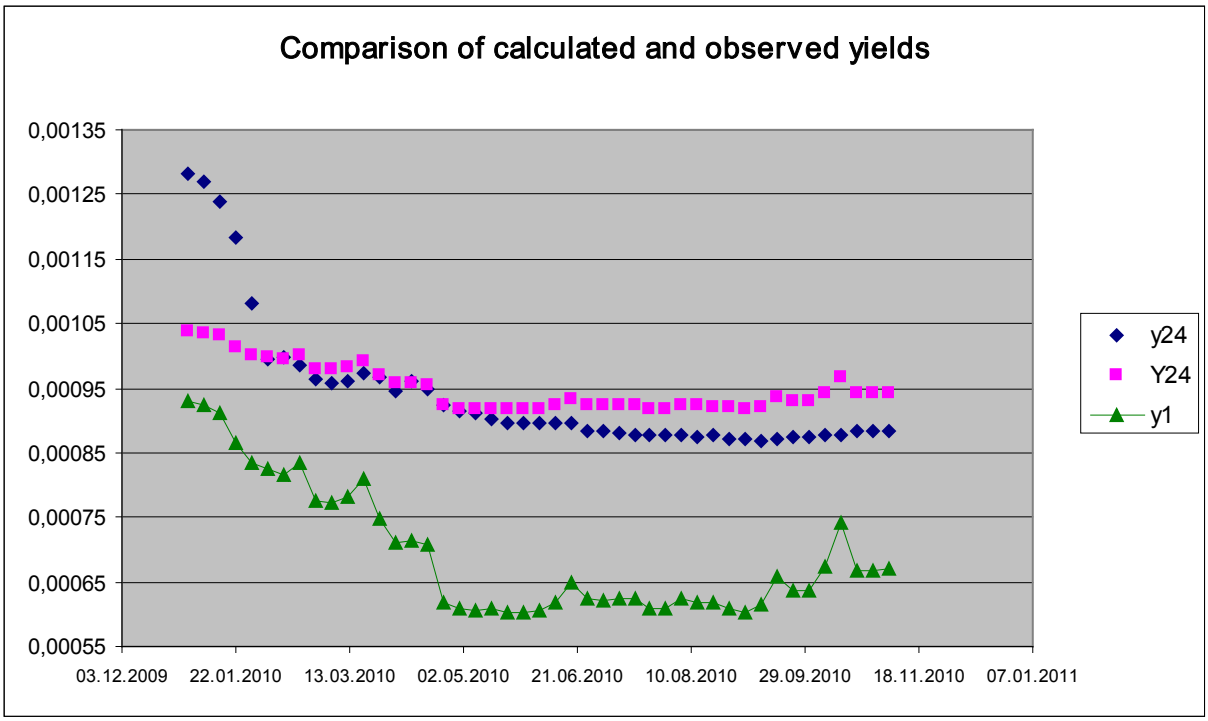

Fig. 5. Calculated (Y24) and observed (y24 and y1) yields.

Thus we see that the application of the proposed model of arbitrage-free pricing of zero-coupon bonds to the data of the credit market in the period of nine months in 2010 exhibits a good consistency with observations.

Appendix 1

Data of «MosPrime» credit rates

date	w1	w2	m1	m2	m3	m6
25.12.2009	4,72	5	5,5	5,75	6,01	6,33
01.01.2010	4,47	4,76	5,3	5,65	5,94	6,25
08.01.2010	4,43	4,75	5,24	5,54	5,79	6,19
15.01.2010	4,38	4,68	5,13	5,38	5,6	6,03
22.01.2010	4,16	4,43	4,86	5,16	5,39	5,76
29.01.2010	4	4,19	4,51	4,66	4,84	5,26
05.02.2010	3,96	4,08	4,27	4,46	4,56	4,84
12.02.2010	3,92	4	4,2	4,41	4,53	4,85
19.02.2010	4,01	4,01	4,22	4,32	4,47	4,79
26.02.2010	3,72	3,82	4,07	4,26	4,39	4,68
05.03.2010	3,71	3,78	4	4,19	4,37	4,65
12.03.2010	3,75	3,89	4	4,21	4,38	4,67
19.03.2010	3,88	3,96	4,11	4,28	4,44	4,72
26.03.2010	3,59	3,79	4,01	4,24	4,42	4,69
02.04.2010	3,41	3,63	3,94	4,16	4,33	4,59
09.04.2010	3,43	3,61	3,96	4,2	4,4	4,66
16.04.2010	3,39	3,58	3,9	4,15	4,31	4,6
23.04.2010	2,97	3,19	3,63	3,94	4,16	4,49
30.04.2010	2,92	3,11	3,46	3,73	4,03	4,44
07.05.2010	2,91	3,09	3,44	3,71	3,96	4,42
14.05.2010	2,92	3,11	3,44	3,73	3,95	4,38
21.05.2010	2,89	3,13	3,44	3,71	3,95	4,35

28.05.2010	2,9	3,1	3,36	3,64	3,87	4,35
04.06.2010	2,91	3,13	3,37	3,64	3,88	4,34
11.06.2010	2,97	3,12	3,34	3,58	3,86	4,34
18.06.2010	3,11	3,16	3,37	3,6	3,86	4,35
25.06.2010	2,99	3,07	3,28	3,53	3,77	4,28
02.07.2010	2,98	3,08	3,29	3,53	3,76	4,28
09.07.2010	2,99	3,08	3,28	3,49	3,75	4,27
16.07.2010	3	3,09	3,29	3,5	3,74	4,26
23.07.2010	2,92	3,08	3,28	3,5	3,75	4,25
30.07.2010	2,92	3,07	3,25	3,5	3,75	4,25
06.08.2010	2,99	3,08	3,27	3,5	3,75	4,25
13.08.2010	2,97	3,07	3,24	3,5	3,74	4,24
20.08.2010	2,96	3,05	3,25	3,5	3,75	4,25
27.08.2010	2,93	3,03	3,23	3,48	3,73	4,23
03.09.2010	2,89	3,02	3,24	3,49	3,74	4,22
10.09.2010	2,95	3,04	3,24	3,5	3,73	4,21
17.09.2010	3,16	3,19	3,25	3,5	3,75	4,23
24.09.2010	3,05	3,11	3,25	3,5	3,75	4,24
01.10.2010	3,05	3,13	3,25	3,5	3,74	4,24
08.10.2010	3,23	3,23	3,3	3,51	3,75	4,25
15.10.2010	3,56	3,48	3,51	3,58	3,78	4,26
22.10.2010	3,21	3,39	3,81	3,91	3,96	4,29

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THE ROLE OF INTERNET - COMMUNICATIONS IN QUALITY CONTROL AND DEVELOPMENT OF INNOVATION ACTIVITY OF ENTERPRISE

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This article discusses the main advantages of the network economy for new business. It is shown that the Internet as a communication tool, is a wide variety of options related to the placement of information on the site, using the media and contextual advertising, direct mail, search engine optimization, which in turn can be integrated using a variety of methods to achieve many goals, including quality control and innovative development of enterprise.

Key words: internet – communications, quality, innovations, information, market.

Information is one of the main instruments for implementing management model for modern market, including the task of quality control of products manufactured by enterprises. In turn, the development of Internet communications has become one of the defining characteristics of the national economy.

National and global economy contains a complex network of interacting markets related with exchange processes. The main advantages of the network economy for businesses today are as follows:

- usability, since the website is available around the clock;
- Cost savings, because companies can be in direct contact with suppliers, manufactures, distributors and customers in terms of the actual lack of geographical boundaries and subject to availability out to all markets of the world;
- Personalization, meaning that users can orient the sale pursuant to the requirements of customers for quality products, using modern information technology to automate the process and obtain valuable intelligence on the market [1].

Management model of the modern economy includes four main elements: interest, investment, innovation, integration. The interest expresses company's ability to operate in conditions of development of the information society and the new economy. The investments imply a financial source and the willingness to invest. The integration highlights the characteristics of the enterprise, involves pooling sovereignty and cooperation of participants. The innovation - it is something without which the company would not be able to properly compete in the market by offering new methods of sales promotion, sales, technical, economic and organizational innovations.

Internet can be considered as a complex and multiplicative form of development cooperation convenient for businesses in the new economy. Opportunities of the networking serve as the target market, in which his subjects effectively achieve their goals.

Controlling the quality of products, reducing development time and output it to the relevant product market as well as providing testing of finished products, companies are

adapting to the market in real time. From this perspective, the time factor is one of the main sources of competitive advantage of the enterprise and factor in reducing transaction costs. Specificity of the decision making process is manifested in the reduction cycle of the planning process, the transition from traditional analytical process to the strategic experimentation, including developing ways of hedging new risks and the implementation of several ancillary business conducted simultaneously.

The basis for the ongoing changes in enterprises is a quality reclaimed products, as well as efficient use of the existing structure of assets and other components that are interconnected significant information (known brand, manufacturing technology product or service, customer base, human resources).

The modern market requires much more than just creating a good product or service appointment at him attractive prices and making it available to target consumers. The company communicates with its customers and suppliers, which includes advertising, sales promotion tools, service policy, personal selling, participation in fairs and exhibitions, working with the media and other activities.

When solving problems associated with forecasting and justification of product quality and selection, development and management of innovative model of communicative Internet policy, emphasizes the use of the concept of "Internet environment." It is defined as the set of factors of Internet space, which impact on the company, implementing Internet-based technologies in their business activities. Dealt is the totality of those factors, which are designed to promote products or services in this new information channel: audience, its characteristics, infrastructure, transaction and communicative structure.

Internet is already held socio-economic and technical system that has a significant impact on the development of innovative enterprises, the global economy and on society as a whole. In general, the Internet, as an economic system can be characterized by properties such as global, openness, heterogeneity, interoperability, etc. [2].

Customers appreciate the enormous potential of the Internet and information tend to react negatively to treatment whose sole purpose is to sell goods or services. They can decide what information on goods and services and under what conditions they want to receive. On the Internet, it is the user and not the supplier company decides about the interaction.

Web users have constant access to unlimited sources of data, so that they become informed demanding buyers. They have the opportunity without resorting to manufacturers or resellers to obtain the necessary objective information about products with various trademarks, including prices, features, and product quality, advertising and initiate obtaining information from manufacturers and retailers, as well as use the software to search and solicitation numerous sellers .

New features of online consumer mean that he becomes the initiator and leader of the exchange, thereby actively influencing the quality of goods and services. Business entities and their representatives can only wait for an invitation to participate in the consumer exchange. Buyers themselves determine what information they need and what they are interested in offers.

Currently innovation enterprise largely depends on the efficiency of use of strategies such as the speed of business processes, expand the product range, product quality control, customization based on personalized marketing, ownership information, and access to world markets.

Business information as part of the business has its function and scope. In turn, the information associated with business information, which is not only a commodity, but also resource production, it means of improving a commercial or industrial activity. [3]

The use of traditional communications technologies, such as fax or wireline phone today quickly replaced by new technologies - instant messaging, e-mail, voice and video over the Internet. Currently, there are a number of products and services, the realization of which is

provided by one or another model of communication. Now through the Internet in Russia successfully sold items such as books, appliances, telephones, the quality of which is no doubt the buyers. Companies organize support services and hotlines for consumers, allowing them to control the process of communication.

The Internet uses the traditional scheme of "source - the message - the recipient", sometimes keeping it in its original form, and sometimes giving it an entirely new character. Communication via the Internet can acquire completely different forms, ranging from the world's web sites administered by the major news organizations to thematic portals and corporate or individual blogs.

Improving communication tools now largely associated with the development of so-called virtual contacts, virtual presence and move to specific points in economic space.

Series of information technology innovation in the means of communication and information exchange is gradually changing economic environment, expanding the boundaries of the possible interactions. To these features were used continuously requires the development of new or modification of existing institutions to implement the interaction of people in these new boundaries.

In XX century, there was a significant breakthrough in technological development of vehicles, as well as the informational and technological advances in the development of communication technologies (electronic exchange of information). As a result, there was another expansion of the boundaries of both real and virtual human interactions.

At the present stage of development of information technologies in Russia, most companies are clearly aware of the need to use the Internet in their business. Currently, however, is not enough to work well and having a high quality contemporary content of the site: to stand out from competitors, it is necessary to reach the maximum number of potential customers and partners. Therefore, it is advisable to use all available resources for the development of Internet business enterprise and to ensure high product quality and competitiveness.

For the particular case of communication in the Internet depending on the scope of the enterprise, promote services, features of the site and the budget should choose those methods of communication that will be in this case, the most effective. Successfully solve this problem allows media planning - developing a detailed plan of communication influences that describes the types of advertising materials, platforms (websites), timing and types of accommodation for them, advertising and charging the alleged efficiency. Media Plan defines the exact advertising campaign strategy, as the set of actions to attract consumers to products or services of the enterprise.

In reviewing the information distribution channels is important to determine what methods can be communicated to the consumer goods and services in the Internet: related sites and portals with a wider audience, e-mailing, search engines, PR and other methods.

Internet, as a tool for advertising, significantly different from traditional advertising media, not only in their properties, but also applicable approaches. Since the main feature of the organization of advertising in it is its two-level building.

The first link advertising on the Internet is in the form of outdoor advertising banners, text blocks and other media, and posted on the popular theme \ ue sites or e-mailed. It can also be advertising using search engines, directories, mailing lists, etc. The main objective of outdoor advertising is to attract users to \ ¥ et company website, although they may be prosecuted, and other purposes. The second (and central) link advertising on the Internet is a communications \ ue site, representing the bulk of information about the company.

Website is a representation of each company on the Internet. From how it looks, how it's interesting how his work and structure of the target audience understand how quickly it works, etc., develops and attitudes on the part of consumers. Highlights that are worth paying

attention to are: design, usability, speed download and work program part, the content of the site and services provided to the user, feedback from visitors and the opportunity to communicate with representatives of the company or the local Internet community.

Banner ads on thematic or nationwide websites plays an important role. It means placement of created texts or graphic banners on technology portals, search engines, newsletters, using targeting by geography, time display, topics and sections. For advertising specialist media advertising in RuNet has the same semantic meaning as advertising in traditional media, but unlike other channels of communication has several advantages. The Internet provides a speed of information exceeding the potential of radio and television. If the publication of the material in a conventional newspaper required days or hours at best, for the advertising on the site takes a few minutes.

Existing management systems online - allow advertising to advertise and monitor advertising campaigns simultaneously on many different web sites using both its own engine placement and integrated with a centralized system. It is well known that a large number of visitors wanting to buy something or choose use the search engine. In order to most effectively convey information to the target audience, there are two methods of using search engines.

Search Engine Optimization - a set of actions taken to achieve high rankings in search results for specific queries, obviously attracting interested visitors looking for this information at any given moment.

The second way to promote via search engines - using contextual advertising - display advertisements (blocks of text or graphic banners) different formats in the search results of leading search engines based on specific words and phrases. Subject analysis of the use of a particular method of promotion in search engines is quite bulky, but most experts agree that search engine optimization, wearing a long-term effect is more advantageous and, in fact, is not online advertising, and a way to market products or services through internet marketing.

Often impossible to do without the use of contextual advertising, for example, that there is, if for queries that held promotion, long-term work is needed to optimize site content, the addition of materials and increase reference ranking for phrases.

Contextual keyword advertising targeted by geography, can help reach the required audience. Contextual keyword advertising allows you to get the most relevant audience. This is such an effective targeting, which has never been and will not have television, no radio, no print media. It is for this reason that worldwide advertisers are spending more money on search engine marketing.

Important tool for promoting information about goods or services is e-mail. Most businesses know that doing your own mailings can effectively communicate with customers and partners, to keep them abreast of changes and news, as almost every Internet user has your email inbox. This way, providing the opportunity to convey to the person concerned, personalized information. Knowing what subjects mailing reads the target audience, as well as having information about its geographical location, it is possible to allocate this amount from the very people who could potentially be interested in a particular product or service.

The biggest problem with any kind of promotion via e-mail is spam - almost useless advertisement sending unwanted spam subscribers. As low response from spam similar mailing carried large volumes. As a result, every person who had the imprudence to openly write your email address on the forum or website is inevitably facing the threat of receiving data messages, and the "public" in this address, the greater the likelihood of such. Used recently analyzers and spam filters have somewhat improved the situation, but can not completely prevent users from this problem.

Plays an important role direct marketing - interactive marketing system where in order to obtain a measurable response from consumers and / or implementation of the transaction uses one or more advertising media. Direct marketing is widely used in the markets both

consumer and business products, as well as fundraising charities. Many businesses are practicing integrated marketing communications (integrated direct marketing), applying for advertising influences multimedia approach that is more efficient than using only one program "media" channel.

The above approaches are associated with using the Internet as a means of communication, largely contribute to the successful solution of a set of objectives for managing product quality and the development of innovation in enterprises.

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CATEGORICAL REPRESENTATION OF THE MODEL OF THE KNEE

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In this article, we proposed a categorical model of the knee joint, which allows the state to objectify the joint, ie diagnosis and forming technology allows treatment (therapy), more correctly, as under certain rigidity and elasticity ligaments.

Keywords: knee, categorical model, the diagnostic condition.

Knee joint with anatomical and physiological point of view is a complex system in the structural and functional relationships. All the elements are nonlinear joint physical environments . Joint mobility determines the nature of the spatial behavior of all other organs of human movement . Finally, it should be noted that any parameters describing joint strictly individualized. In this regard, the correct choice is extremely important medical and rehabilitation technology that is largely determined by the achievement of the following objectives:

1. Description of the phase space of the knee joint observation and selection of information parameters for the implementation of a systematic approach in the framework of the measurement process ;

2 . Synthesis of the structural model of the force interactions between the elements of the knee ;

3 . Distribution of analytical formalisms describe the elements of the main contacts of the knee.

The correct choice of treatment and rehabilitation technologies by controlling elements of the joint force interactions advisable objectify introduction model diagnosable condition:

$$M_{dfs} = \{\mathrm{M}_{\mathrm{fus}}, M_{oon}, M_{fk}, M_{usf}, M_{cn}\}, \quad (1)$$

M_{dfs} - model diagnosed physiological state;
M_{fus} - physiological model of the functional system (FFS);
M_{oon} - a model of the domain of definition of the FSF;
M_{fk} - physiological model constants;
M_{usf} - model operating conditions;
M_{cn} - a model of the system parameter.

On the basis of anatomical diagrams of the knee (1) Draw a block diagram of the structure of interactions between its elements (Fig. 1).

The formal structure of the image is a graph of inter-element interactions of the form (2). Here, (2) the following notation:

KRSV1 2 - cruciate 1 and 2, respectively;
PSV - transverse ligament;
SHG - tendon;
TR - friction;
BC - thigh bone;
Minigap - condyle;
BBK - tibia;
MBC - fibula;
MH - meniscus;
BBKSV - tibial collateral ligament;
NC - patella;
SVNK - patellar ligament;
BSV - femoral ligament.

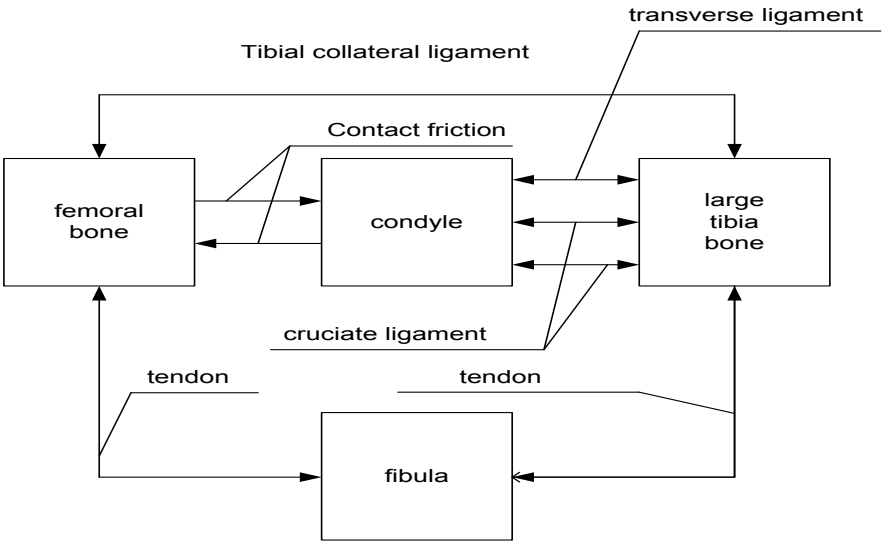
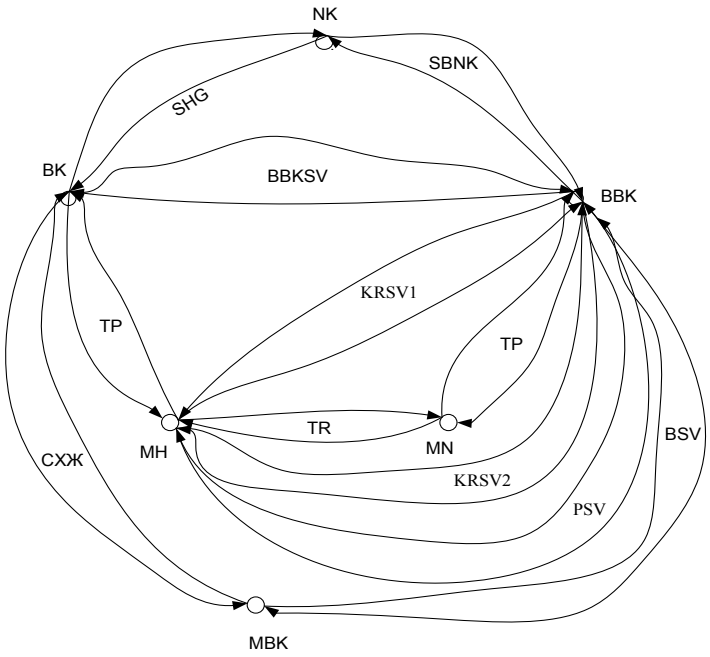


Figure 1. Structure of inter-element interactions



(2)

Using the graph, you can make a categorical system [2] power interelement interactions:

$$\left.\begin{array}{c} M_{бкнк} \subset (БК, НК) \cup (НК, БК), \\ M_{ббкнк} \subset (ББК, НК) \cup (НК, ББК), \\ M_{бкббк} \subset (БК, ББК) \cup (ББК, БК), \\ M_{бкмщ} \subset (БК, МЩ) \cup (МЩ, БК) \\ M_{мщмн} \subset (МЩ, МН) \cup (МН, МЩ) \\ M_{мщббк1} \subset (МЩ, ББК)_1 \cup (ББК, МЩ)_1 \\ M_{ббкмн} \subset (ББК, МН) \cup (МН, ББК) \\ M_{бкмбк} \subset (БК, МБК) \cup (МБК, БК) \\ M_{ббкмбк} \subset (ББК, МБК) \cup (МБК, ББК) \\ M_{мщббк2} \subset (МЩ, ББК)_2 \cup (ББК, МЩ)_2 \\ M_{мщббк3} \subset (МЩ, ББК)_3 \cup (ББК, МЩ)_3 \end{array}\right\} \quad (3)$$

Here the indices 1,2,3 correspond to the categories $(МЩ, ББК)_i \cup (ББК, МЩ)_i$ in the first and second cruciate ligament (codes 1 and 2) and the transverse ligament (code 3) Since the elements of БК, ББК, МЩ, МН, НК and МБК included in one or another combination of all categories of (3) , so far the system is adequate to correctly model the functional system Mfus .

Category (3) may be supplemented with information about the types of structural elements and connection types loading coupling elements . For this purpose built matrix of connection types and types of loading.

Every model involves the use of numerical characteristics of its individual elements , their nature and distribution pattern model . In this case, the assignment of numerical values based on the fact that the bunch - is dense connective tissue bands and plates that connect the

skeletal bones or individual organs . Located mainly in the joints , strengthen them, limit or direct the movement of the joints. In this case all the ligaments have physical characteristics in accordance with their individual appointment .

Thus, the categorical model of the knee joint allows objectify state , ie diagnosis. It gives you the opportunity to shape the technology of treatment (therapy) , more correctly , as determined by hardness and elasticity of ligaments .

The proposed formalization of behavior of the knee joint is correct , thanks to the generalized category description , and at the same time allows the required specification , defined by the individualization of the object itself. It involves a clear sequence analysis of the physiological state of the object and contributes to the development of information technology in medical and rehabilitation technologies.

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OPTIMIZATION OF TREATMENT METHODS OF BACKGROUND AND PRECANCEROUS DISEASES OF THE CERVIX UTERI IN OUTPATIENT GYNECOLOGY

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Cancer of the cervix uteri (cervical cancer) takes the 2-nd place in the structure of cancer diseases, after breast cancer and takes the 1-st place among the reasons of female mortality of cancer in developing countries. One of the tasks of practical gynecology is accurate selection, appropriate therapy, competent regular medical check-up of patients with benign and precancerous cervix uteri diseases. Physiosurgical methods are the leading methods in diagnostics and treatment of cervix uteri diseases. Development and adoption of new more effective technologies in doctors' practice is one of the important problems of gynecology. [1, 2, 3, 4].

The goal of the research is estimate of efficiency in practicing of wideband radio-wave surgery in outpatient gynecology for women with background and precancerous diseases of cervix uteri.

Materials and methods

The results of the outpatient examination and treatment of 150 patients with background and precancerous conditions of cervix uteri in the age from 17 to 56 were analyzed. The average age of the patients was 26±3,2 years. Clinical, microbiological, immunological, endoscopic (colposcopy, vulvoskopy), ultrasound, cytological, histomorphological methods were taken during patients' monitoring survey. Menstrual disorders were found in 22 (14.7%) women. 137 (91.3 %) patients had a history of pregnancy, including childbirth - 122 (81.3%) , childbirth and abortion - 78 (52%) , only abortions - 13 (8.7%). 42 (28%) patients suffered from obstetric trauma of cervix uteri (cervical rupture of II-III degree). Substantial proportion of women - 82 (54.7 %) had Sexually Transmitted Diseases, including chlamydia and mycoplasmosis - 43 (28.7%), Papilloma Viral Infection -21 (14%). All women from our study suffered from vaginosis, many of them had chronic salpingoophoritis - 94 (62.7 %), cervicitis - 78 (52 %), vulvovaginitis - 105 (70 %). In 24 cases warts of the vulva and vagina were diagnosed, including five women under 25 years old. During endoscopic examination (vulvoskopy, colposcopy) the following diseases were identified: pseudo erosion - 102 (68%) , 23 of them with recurrent pathology, ectropion - 28 (18.7%), hypertrophy of cervix uteri in combination with retention cysts - 4 (2.7%), leucoplakia - 8 (5.3%), cervicitis - 78 (52%), vulvovaginitis - 105 (70%), trema and vagina condyloma - 14 (9.3%), cervix uteri condyloma - 8 (5.3%), cervical polyps - 15 (10%). In 23 (15.3%) cases detected pathology combined with the CIN I-II degrees. 3 (2%) patients had cancer in situ, 2 patients (2%) - cervical cancer of I stage.

Therapeutic correction and monitoring of patients with background and precancerous conditions were made gradually.

On the basis of research results the first step included d-bridement of infections, vaginal biocenosis neoformation, immunomodulatory therapy and drug treatment.

The second step included surgical correction using radiosurgical portable device "Surgitron ™» produced by «Ellman International, inc. » (USA), the output frequency - 3.8 MHz. There were three operating modes: clean cut (90% cut and 10% -coagulation), incision and coagulation (50% cut and 50% - coagulation) and hemostasis (90% coagulation). *Radioconization* and radioexcision were made by loop electrodes within healthy tissue; hemostasis was made by ball electrode.

Radiosurgical treatment was carried out in the first phase of the menstrual cycle, allowing to exclude the presence of pregnancy and improve the course of reparative processes.

Results and their discussion

Treatment by radio wave surgery was performed in the following amounts: 58 (38.7%) patients were made target biopsy of the cervix uteri, 66 (44 %) patients – *radioconization* of cervix uteri followed by radiocoagulation in the focus of conization, 28 (42.4%) - eroded with ectropion, 23 (34.8%) - with cervical intraepithelial neoplasia of I-II degree, 15 (22.7%) - with cervical canal polyps .

54 (36 %) patients had radioexcision followed by radio-pectization of the center of excision (8 [14.8%] - with leukoplakia , 4 [7.4%] - with hypertrophy of cervix uteri in combination with retention cysts , 42 [77.8 %] - with ectopic in conjunction with the deformation of the cervix uteri). The remaining 30 (20%) patients made radiofrequency *coagulation* of cervical ectopia.

Loop electrodes were used with cutting mode, power 3-4.5 units. Pectization with ball electrode was made in the mode of monopectization, power units 4-5. There were no perioperative complications. It appeared a fibrin deposit after radiosurgical treatment, which was rejected by 8-14 day. There was hemorrhage in the zone of influence after the film's rejection in 6 cases, and it was stopped by vaginal tamponade. Use of radiosurgical methods of background and precancerous cervix uteri disease treatment helped to reduce the duration of the operation and get high quality biopsy for histology and morphology control. The thickness of the necrosis zone after exposure to the "Surgitron ™» was only 0.04 mm. It took from 28 to 45 days for the full epithelialization of the cervix uteri. Patients were followed up for 2 years (once every 6 months). Exacerbations were diagnosed in 5% of the observed patients.

Conclusion

Use of radiosurgery in the correction of background and precancerous disease of cervix uteri is a highly effective and affordable method of surgical treatment. Radiowave method can significantly reduce the traumatic factors and duration of surgery, blood loss, which allows to realize diagnostic and therapeutic manipulation with cervix uteri in outpatient settings.

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RESULTS OF TWO YEAR EDUCATION PROGRAM OF PATIENTS WITH CORONARY HEART DISEASE, COMBINED WITH TYPE 2 DIABETES MELLITUS

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The aim of this study was to estimation of results of two year education program of patients with coronary heart disease, combined with type 2 diabetes mellitus (after 12 and 36 months of training).

Methods. Three hundred nineteen patients (PTS) with coronary heart disease (CHD), accompanying with type 2 diabetes mellitus (T2DM), who underwent percutaneous coronary intervention and/or coronary artery bypass graft surgery, were investigated. From them 165 PTS (group 1) were educated in school for patients with combined diseases and 154 PTS (group 2) have a traditional therapy only. Patients (n=303) with secondary arterial hypertension, discirculatory encephalopathy III st., heart failure IV functional class, chronic kidney disease 3-5 stage were excluded from research.

Educational program of patients with combined diseases includes 12 lessons.

Part I. Coronary heart disease (4 lessons):

1. Epidemiology, risk factors. Anatomy and function cardiovascular system. Pathogenesis of CHD.
2. Clinic, diagnostics and treatment.
3. Atherosclerosis, dyslipidemia: pathogenesis, clinic, diagnostics and treatment.
4. Interventions on coronary arteries: needs, types and variants of restoration of a blood-groove, clinical results. Rehabilitation, dynamic supervision.

Part II. Diabetes mellitus (4 lessons):

5. Incidence, risk factors, co-morbidity.
6. Features of a syndrome of mutual burdening at combination of CHD and T2DM.
7. Features of surgical interventions on heart coronary vessels at patients with CHD in combination with T2DM.
8. Rehabilitation, dynamic supervision, “The diabetes mellitus is mode of life”.

Part III. Self - control of a functional conditions (2 lessons):

9. Coronary heart disease and T2DM, features of self-checking of the organism's basic functions at combined diseases. Measurement the blood pressure (BP), pulse, waist circumference, body mass index, total cholesterol levels and triglycerides.
10. Importance of command in training the patient with combined pathology (the cardiologist, endocrinologist, neurologist, ophthalmologist etc.). Self - control of a blood glucose level, glycated hemoglobin (HbA1c).

Part IV. The General problems and a feedback (2 lessons):

11. Training to instructions for use and a critical estimation of the medical information received from various information sources (the newspaper, TV, the Internet - resources, fair brochures and booklets).
12. Interview by results of training.

Results. It is shown that training of patients leads to increase in awareness and knowledge of risk factors of combined diseases’ development, adherence to therapy (from 52,1% to 94,5% and 96,3% through 12 mo and 36 mo respectively (p<0,001). and improvement of quality of life of patients from 46,7% to 87,7% and 91,3% through 12 mo and 36 mo respectively (p<0,001), decreased hospitalization concerning complications of CHD and T2DM in 1,4 times and byeffects of medicine therapy from 32,7 % (before the education) to 11,0 % in 12 mo, and have increased to 15,6 % in 36 mo, but is significant (p<0,001) remained more low, than prior to the beginning of education (Table 1).

Table 1

The results of two year education program of patients with coronary heart disease, combined with type 2 diabetes mellitus

Indicators	Before education (n=165)		After 12 month of education (n=163)		After 36 months of education (n=160)	
	Abs	%		%		%

Awareness of risk factors of CD	98	59,4	163	100,0	159	99,4
Knowledge of CD	56	33,9	163	100,0	154	96,3
Hospitalization concerning complications of CHD and T2DM	95	57,6	68	41,7	81	50,6
Self - control of a blood glucose level, BP	98	59,4	160	98,2	154	96,3
Quality of life	77	46,7	143	87,7	146	91,3
Adherence to therapy	86	52,1	154	94,5	154	96,3
By-effects of medicine therapy	54	32,7	18	11,0	25	15,6
Blood glucose level (mmol/l)	7,5		6,4		5,9	
HbA1c (%)	7,3		6,8		6,2	

Notes: BP- blood pressure; CD - combined disease; CHD - coronary heart disease; HbA1c - glycated hemoglobin; T2DM - type 2 diabetes mellitus

Conclusion. Thus, training of patients with combined pathology based on educational program leads to increase in knowledge and understanding of risk factors of development of accompanying illnesses, adherence to therapy and improvement of quality of a life of the patients. Self control of the BP and blood glucose level, brought to the stable compensation of diabetes mellitus and hospitalization reduced of concerning complications CHD and T2DM in 1, 4 times and by-effects of drug therapy.

OPTIMIZING TREATMENT OF TROPHOBLASTIC DISEASE

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In this article the problem of diagnosis, treatment and monitoring of trophoblastic tumors in regional cancer centers, the need to put into practice the specialized agencies worldwide standardized chemotherapy regimens and organ operations, allowing not only to heal the young women, but also to keep them reproductive function.

Keywords: gestational trophoblastic neoplasia choriocarcinoma , human chorionic gonadotropin .

Trophoblastic tumor (TT) (trophoblastic neoplasia " TN ") - malignant tumor derived from embryonic trophoblastic tissue . TN generalize a group of related forms of pathological conditions trophoblast: invasive hydatidiform mole, horiokortsinoma , trophoblastic tumor placental, epitelioid trophoblastic tumor. TT involve pregnancy, so predominantly affect women of reproductive age [1].

Clinical manifestations of trophoblastic disease by now well understood. Widespread introduction of modern diagnostic methods (determination of serum beta - hCG , UZKT, immunohistochemical study of rocketry, MRI) has greatly improved the possibility of early detection of disease and accurate assessment of the spread of the tumor process[2].

At the present stage TN standardized treatment. Years of international experience treatment planning based on risk of tumor resistance to the WHO scale showed excellent results

1 line chemotherapy achieves high survival (100% low-risk and 90% or more high-risk patients)[3]. But at the same time, significant progress anticancer drug therapy does not reduce the importance TT surgical removal of the primary tumor resistant and solitary metastases, which often leads to complete remission in patients with very poor prognosis. Widely implemented in practice organ operations can not only heal patients with resistant tumor of the uterus, but also to keep them reproductive function [4, 5, 6, 7, 8, 9].

Demonstrable progress of chemotherapy in these patients raises the problem of optimization of this type of treatment and the introduction of such a standard in clinical practice all specialized centers

Trophoblastic tumor is a rare disease among all malignancies in women, which is one of the reasons for the low level of methodological examination of patients , both at the level of gynecologists and oncologists. Delayed diagnosis TT different from other tumors aggressive course early distant metastasis, conducted inadequate chemotherapy, failure of modern algorithms of diagnostics and monitoring in the treatment process, contribute to the emergence of resistant tumors and death of potentially curable patients [10, 11, 12]. Given that the disease predominantly affects young women during the reproductive activity, priority problem becomes apparent [13, 14, 15].

Objectives of the study: Based on a retrospective analysis of data treatment trophoblastic disease develop adaptive, efficient algorithms for diagnosis and treatment of TT to development of specialized centers.

Materials and methods

Retrospectively studied the medical records: information on a patient with an established diagnosis of choriocarcinoma, demographic, clinical and pathological, morphological data, information on monitoring, treatment and outcome.

Take into account the patient's age at the time of registration in the database, the outcome of the last pregnancy and the time interval that has elapsed since its completion, the level of human chorionic gonadotropin (hCG), localization and number of metastases, current treatment - surgery or chemotherapy. The study included patients (n = 35) who received treatment for trophoblastic tumor in the surgical department of gynecological oncology ROD for the period from 1997 to 2010 The age of patients ranged from 19 to 55 years.

In accordance with the classification of FIGO (2000) distribution by stage was as follows : I stage - 19 (54.2 %) patients , II stage - 5 (14.2%) patients , III stage - 11 (31.4 %) patients , stage IV - patients not.

Previous pregnancy outcome were : hydatidiform mole in 13 (37.1 %) patients , abortion in 18 (51.4 %) patients , delivery in 4 (11.4%), ectopic pregnancy - was not. The interval from the end of pregnancy before signs of the disease ranged from 1 month to 5 years. Based on the analysis of the data, the scale factors of the WHO (2000) evaluated the risk of development of tumor resistance. Revised staging according to the criteria of classification of trophoblastic neoplasms combined FIGO and WHO (2000).

Results

Initial evaluation and monitoring during and after treatment were not made standard for all patients. Determination of the functional activity of a biological marker for trophoblast B subunit of human chorionic gonadotropin was carried out at the initial examination and during treatment, only 10 (28.5 %) patients, but the frequency does not conform to the standardized norms. More in 10 (28.5%) patients hCG titer determined once after evacuation, or during treatment. In 15 (42.8%) cases of hCG titer is not fixed at any stage. In 19 (54.2 %) patients in this group the tumor was represented only by the primary focus.

Table 1

Localization of metastases

Localization of metastases	Abs (%)
Lungs	11 (31%)
Vaginal wall	2 (5,7%)
Ovaries	2 (5,7%)
Parameter	1 (3%)

Pathological confirmation type tumors (choriocarcinoma) was obtained in 31 (88 %) cases. Samples of tumors studied only classical microscopic analysis without the use of ancillary techniques (immunohistochemistry). In 4 (11.4%) cases and no verification of morphological diagnosis is on the basis of laboratory and instrumental methods. Surgical activity in this group was 22 (62%) of observation, 16 of them (72.7 %) cases of volume is hysterectomy with bilateral tubovarioektomy, 6 (27.2 %) - supravaginal amputation of uterus with bilateral tubovarioektomy .

Table 2

Statement for surgical treatment

Statement	Abs(%)
Bleeding from the tumor	18(81,8%)
Tumor Resistance	3(13,6%)
The threat of perforation of the uterus tumor	1(4,5%)

Chemotherapy held all 35 (100%) patients, including independent and chemotherapy (n = 13). The analysis showed that the treatment of patients scheduled without the risk of developing resistance trophoblastic tumor. Only 7 (20 %) patients carried a standard chemotherapy regimen 1 line for patients with a low risk of tumor resistance presented regime methotrexate 50 mg DM 200 mg, 6 mg of leucovorin 24 mg DM: complete remission (n = 1), the resistance of the tumor (n = 2) , postoperative courses were on stage (n = 4). In 28 (80%) cases held nonstandard chemotherapy.

Conclusion

Low level of methodical examination of patients in combination with empirical experience emergency intervention, treatment planning without risk of resistance, standard chemotherapy - this is our "gold standard" - a reference point from which we leave the last 4 years with a slight positive, more in the staging of the solutions problems of diagnosis and treatment of trophoblastic disease.

The volume of specialized medical care in cancer centers should be developed taking into account the diagnosis and treatment algorithms based on an assessment of risk factors and resistance standardized chemotherapy regimens.

MULTILEVEL ANALYSIS ONCOSURGERY ASSISTANCE AND IMPROVEMENT OF ONE-STAGE RADICAL SURGERY ON THE ESOPHAGUS AND GASTRIC CARDIA.

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Malignant neoplasms because mortality steadily compete with cardiovascular disease, 200 cases per 100 thousand population.

There is speculation that the same factors underlie cardiovascular and cancer diseases, in particular, associative solved challenging task hormone - dependent cancers (Table 1, 2).

Table 1.

Life expectancy and mortality in Okinawa and other parts of the world

Country (region)	Life expectancy		Food type	Level of mortality (per 100 thousand people)		
	Rating	Years		CHD	HDC	Stroke
OKINAWA	1	81,2	Eastern and Western	18	21	35
Japan	2	79,9	Asian	22	34	45
Hong Kong	3	79,1	Asian	40	29	40
Sweden	4	79,0	Nordic	102	115	38
Italy	8	78,3	Mediterranean	55	81	49
Greece	10	78,1	Mediterranean	55	65	70
USA	18	76,8	American	100	87	28

* CHD - coronary heart disease; HDC- hormone-dependent cancer

Disease risk from coronary heart disease and hormone-dependent tumor diseases in the U.S. is significantly higher than in Okinawa (Japan), respectively 5,6 and 4,1. Who takes on particular issues without solutions to common, every step is faced with general questions.

There are general conditions that contribute to the tumor. Each cancer has its own spectrum of cancer before metabolic changes, hypercholesterolemia , atherogenic factor up to psychophysical health (1,2,3) .

Cancerous disease - is poly and monogenetic etiologic process. Over the past 20 years the incidence of cancer in France increased by 60%. Prostate cancer in the Nordic countries over the last 20 years has tripled, while the U.S. has increased by 258% (4, 5)

Table 2.

Life expectancy and mortality in hormone-dependent cancer of different localization in Okinawa and other parts of the world

Country (region)	Life expectancy		Food type	Cancer localization Level of mortality (per 100 thousand people)			
	Rating	Years		Breast	Ovaries	Prostate	Colon

OKINAWA	1	81,2	Eastern and Western	6	3	4	8
Japan	2	79,9	Asian	11	3	4	16
Hong Kong	3	79,1	Asian	11	3	4	11
Sweden	4	79,0	Nordic	34	10	52	19
Italy	8	78,3	Mediterranean	37	4	23	17
Greece	10	78,1	Mediterranean	29	3	20	13
USA	18	76,8	American	33	7	28	19

We must ask the question - is an epidemic? At the same time in Okinawa, breast cancer, prostate cancer - a rarity. Problems of ecology, economics, genetics are the result of anthropological crisis . Without solving the problems, including social ecology , even a perfectly functioning and available to all segments of the population medicine, cannot return to the person lost health .

The strategy of creating socio-economic conditions with finding trade-offs in the triad: ecology, economics, genetics is a predictor for the determination of the nation's health.

Forty percent of cancers can be prevented by a modifying in diet, physical activity, and taking into account environmental factors (4, 5).

There is a variant of flow malignancy for which there is no sinister combination of chronic precancerous background of the disease, the negative epidemiological component, cancer affects those who had never smoked and whose life is harmonious and balanced, which allows us to formulate the definition of a cancer -like disease genome structural and functional changes in genes that determine the occurrence of tumor growth.

More alarming situation in thoracoabdominal oncosurgical specialty.

Overall 5-year survival for reasons - leaders in the structure of disease: lung cancer , esophageal cancer, stomach cancer, hepato- pancreatic - duodenal area according to TJ. Priestman (2001), is 11%. Therefore cancer priority problem tasks raised to the rank of state policy and aimed at a radical reduction in the incidence, mortality, access to the leading position in the global oncology for 5 years, with 5 - year survival of 44%.

Is this possible, and how?

Need concept of health development. It is, but does not work.

Necessary doubling of public health financing until 2014, with a minimum of 6% of GDP, but there is no increase .

In order to detect tumors, even in high-risk groups through public oncoprogramm screening today is designated as a problem because of the insolvency of socio- economic status. In civilized countries, the human potential - the main component of the national wealth, then on the importance designated socio-economic status. The third component of human development is education and awareness.

We raw concept.

Only philosophical analysis of the educational environment motivated program will highlight the question.

This paper summarizes the results of landmark 13 -year clinical studies (2000- 2013) on the issue of treatment of diseases oncosurgical esophagus and gastric cardia. This radical surgery increased complexity on the chest, abdomen and neck.

Development of new high-tech operations expanded range of more physiological operations: spleno - the pylorus preserving gastrectomy with the inclusion of duodenal transit

virtually displacing standard gastrectomy status of "gold standard" for 1 and 2 -stage cancer of the proximal part of the stomach (patent number 2417771 from 10.05.2011)

In clinical material included 766 patients (PTS), who were divided into four groups.

Dysphagia occur on the etiopathogenesis , pathophysiological entity morphological substrate heterogeneous disease entities , including neuromuscular diseases of the esophagus, Barrett's esophagus , strictures of the tumor , chemical, peptic , tuberculosis , collagenous etiology (6). Therefore, to determine the surgical approach , optimizing medical - diagnostic complex core is the question of differential diagnosis of the principle "from simple to complex" of non-invasive methods , with a screening value to the inclusion of highly informative NMR, CT , which will qualitatively formulate a diagnosis .

The first group consisted of 202 patients after operations type Lewis modification M.I. Davydov and (or) extirpation of the esophagus by A.F. Chernousov with postoperative mortality 3% (Table 3).

Patients with cancer in stages as follows:

I, II stage - 27 %;

III stage - 52 %;

III - IV stage - 21%.

Used plastic material : small intestine , stomach, and colon.

Graft placement method: in the pleural cavity in the posterior mediastinum , the neck, retrosternal.

Table 3.

Operations in cancer of the esophagus and gastric cardia

№	Title operations	Quantity		Mortality	
		Abs	%	Abs	%
1.	Transpleural resection of the esophagus with simultaneous esophagogastroplasty (operation type Lewis, Garlok in the modification of M.I. Davydov)	166	82,2	6	3,6
2.	Complete esophagectomy with a total isoperistaltic tubular esophagogastro(colo)plasty with anastomosis on the neck by A.F. Chernousov	31	15,4		
3.	Gastrectomy in combination with esophagus extirpation	3	1,4		-
4.	Esophagus extirpation (Dobromyslov-Torek operation)	2	1,0		-
	Total	202	100,0	6	3,0

Second group consisted of 388 patients with gastrectomy , gastroesophageal , ezofagosubtotal resections with postoperative mortality rate of 1.03 % (Table 4). Patients with cancer in stages as follows:

I, II stage - 22 %;

III stage - 50 %;

III - IV stage - 28%.

Table 4.

Operations with cardiac, cardia(gastro)esophageal cancer

№	Title operations	Quantity		Mortality	
		Abs	%	Abs	%
1.	Abdominal cardio (gastro)oesophageal resection with with simultaneous esophagogastroplasty on Savinykh-Karyakin.	138	35,6	2	1,5
2.	Gastrectomy by M.I. Davydov	198	51,1	2	1,0
3.	Suprapylorus gastrectomy by the clinic methodology	32	8,2		-
4.	Gastrectomy with esophagogastroduodenoanastomosis by A. M. Karyakin	11	2,8		
5.	Combined advanced variant with extirpation of the gastric stump	9	2,3		-
	Total	388	100,0	4	1,0

The third group included - 21 patients after reconstructive interventions for «diseases of operated esophagus» with 1 death (4, 8%). (Table 5)

The fourth group included patients (n = 155) after surgery for benign diseases of the esophagus and gastric cardia (Table 6).

Table 5.

The surgical treatment of benign diseases of the esophagus and gastric cardia

№	Title operations	Number of patients
1.	Extramucous esophagocardiomyotomy with esophagoplasty by Geller-Suvorova	42*
2.	Esophagofundoplication by Nissen's method(Kanshin) about cardiofundal hernia with reflux-esophagitis	29
3.	Diverticulectomy	13
4.	Removal leiomyoma, polyps	11
5.	Esophagus extirpation with esophagogastrostomy of abdominal-cervical approach	6
6.	Esophagus extirpation with colon plasty	6
7.	Reconstructive interventions for the «diseases of operated esophagus»	21**
8.	Separation tracheoesophageal fistula including with endoprosthesis replacement, circular resection of the trachea with stenting	15
9.	Operation perform on the neck on the background of compressed esophagus and stridor	10
	Total	**153**

* Nine patients were operate with transthoracal approach

** Death-1 (4, 8%)

Table 6.

Urgent surgical interventions performed in benign strictures of esophagus and gastric cardia

№	Structure and the extent of operation	Number of patients
1.	Elimination of strangulated posttraumatic paraesophageal hernia: а) with organs translocation б) with the reconstruction of cardio-fundal area with the regenerative operation stage	16 7
2.	Surgical removal of foreign bodies from esophagus	13
3.	Gastrectomy with preservation of the pyloric sphincter	3
	Total	39

The main activity was the result of the expansion of indications for esophagoplasty by M.I. Davydov surgical unit which reduces complications, particularly anastomosis of esophagus suture failure.

Effective method of prophylaxis in high -risk pleuropulmonary index, cardiovascular disease was the exception thoracotomy stage operation broader introduction into clinical practice abdomino - frontmediastinal access A.F. Chernousovu , including an aggressive strategy to the implementation of simultaneous superradical operations (n = 37) removing from 3 to 8 organs.

We performed 32 operations with preservation of the pyloric sphincter, which improved functional outcomes with resolution postresectionsyndrome: reflux esophagitis, dumping syndrome with improved quality of life.

Conclusions

1. Multilevel analysis oncosurgical help with the integral approach has shown that there are common links between hormone - dependent cancers and coronary heart disease in correlation with low predictors: free radicals, homocysteine, atherogenic factor.

2. The most frequent complications in early postoperative period after a radical operations on the esophagus are pleuropulmonary and cardiovascular complications.

3. New indications for the modified method for esophagoplasty by M.I. Davydov, a transabdominal and transmediastinal resection, including striping operations in cardio (gastro) esophageal cancer, will provide the solution of task to reduce infectious complications arising as to the insolvency of anastomotic sutures and cardiopulmonary complications.

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FALSIFICATION OF MEDICINES – A FACTOR OF CAUSING DEATH ON IMPRUDENCE OWING TO IMPROPER EXECUTION BY THE MEDICAL WORKER OF THE PROFESSIONAL DUTIES

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The article reveals the factors determining causes of death on imprudence owing to inadequate execution of the professional duties by the medical worker. According to the author, falsification of medicines is the objective reason of commission of this crime. The article also de fines subjective factors of crime in health system.

Determinants of causing death on imprudence owing to improper execution by the medical worker of the professional duties became object of research of many scientists. Studying of determinants of crime in the sphere of public health care is a serious and defining step to carrying out further work on the organization of counteraction to it.

In the criminological theory define various groups of factors of crime in health system. As a basis we to take E.V. classification of Chervonnykh which allocates three groups of the reasons and conditions of the crimes committed in the sphere of public health care. To the number of the general reasons and conditions, the scientist refers crime globalization as a whole; the negative social and economic processes happening in society; sharp change of a public mode (the 90th years); decrease in spiritual and moral potential of the nation; low legal culture and legal nihilism practically all segments of the population; inefficiency of many institutes of the power and some other.

In our opinion, determinants of causings death owing to improper execution by the medical worker of the professional duties are determined by imprudence and occurred in the sphere of publik health care by the essential changes connected, first of all, with unreasoned refusal of system of full budgetary providing given system in the absence of the accurate mechanism of its material support, answering to modern market conditions. Therefore, according to A.P. Solovyov, «the realization beginning in 2006 of the priority national Health project faced a number of difficulties since the state was dependent on private producers and suppliers of the medical equipment and the medicines which are carrying out delivery of this production only after receiving necessary money with which transfer constantly there were failures because of insufficient public financing of the studied sphere». In the sphere of health care it is possible to distinguish complexity of public health systems from the specific reasons and conditions of crimes and as a result, a weak information exchange with the population, low level of supervision from Ministry of Health to official offenses of subordinates, corporate solidarity of medical workers. In our opinion, this circumstance is a factor of latency of causings death on imprudence owing to improper execution by the medical worker of the professional duties.

«There are a lot of the questions concerning criminal prosecutions of persons for violation of professional duties, arises in law-enforcement practice. Difficulties of investigation of this category of crimes and their legal qualification are caused by specifics of the medical activity which explanation without special knowledge in the field of medicine is impossible that causes an important role of a forensic medical examination». Therefore the big massif of criminal cases of medical character stops in the absence of an event or crime structure at the heart of what the biased conclusions of forensic medical examinations lie.

One of factors of causings death on imprudence owing to improper execution by the medical worker of the professional duties is abundance in drugstores of fakes of medicinal production, though the Russian Federation not the only country where there was a «black»1 market of so-called counterfeit (counterfeit) drugs.

The problem falsification medicines is topical today around the world. However, unfortunately, in the Russian Federation producers and the persons realizing forged medicines remain unpunished. In many regions of the Russian Federation some enterprises buy in a lot of overdue medicines expired then on packings of medicines labels with the new expiration date of medicine specified them are re-stuck. Then large consignments of the «refreshed» medicines are implemented in drugstores of the cities of the Russian Federation. As correctly notes N. Anisimova6, which effect they rendered and what reaction at the sick human body treated by specified drugs, they caused, it is necessary to guess only.

The forged medicines can be dangerous in case of emergency when the seriously ill person needs to take the vital medicine urgently. The use of the forged medicines involves causing death and heavy harm to health of citizens. «Even in case such medicines which part neutral components are applied to treatment of the sick person, harm to health of the person is not so much the using of such medicine, as this medicine doesn't render due medical effect and treatment actually isn't carried out, and, nevertheless, the illness can progress and the condition of the patient can worsen only».

However the legislation didn't provide criminal liability for production, fabrication, storage and distribution of the forged and low-quality medicines. «Art. 238 of the criminal code of Russian Federation providing criminal liability for production existing now, storage, transportation or sale of goods and production, performance of work or rendering the services which aren't meeting safety requirements, isn't adequately correct in relation to responsibility for production, the offer to sale, sale, storage, transportation for sale and (or) import to the territory of Russia of the forged medicines. Purchasers of that production are sick people, in communication with what at crimes of this category high degree of public danger and, therefore, responsibility for commission of a such crime has to be more strict».

Complexity of identification of the facts of falsification of medicines is that the forged medicines can be revealed only by examination. If there are no visible damages and medicine corresponds declared in the instruction to application, can understand its authenticity only specialists9. Therefore production and realization of the forged medicines turned into profitable criminal business in the Russian Federation, the fighting with which practically isn't conducted, at least isn't so effective to protect the Russian pharmaceutical market from the forged medicines, and to guarantee to the consumer quality of acquired medicines.

Generalization and the analysis of materials investigative and jurisprudence showed that control authorities practically never submit the case to judicial instances, being limited to removal from sale of the low-quality and forged preparations. As E.I. Tretyakova correctly notes, "it testifies as to weakness of supervisory authorities and imperfection of the legislation as the high corruption potential of pharmaceutical production. And it will proceed until the state won't take concrete measures for fight and the prevention of a turn of the forged medicines».

The third group of determinants of causing death on imprudence owing to improper execution by the medical worker of the professional duties is made by subjective factors: insufficient inspection of the patient, inattentive studying of a medical carol, wrong interpretation of results of laboratory analyses, indifferent and disregard attitude towards patients, criminal negligence, low legal level. As correctly note scientists11, insufficient attention of jurisprudence to a problem of criminal liability of medical workers for professional crimes, and also inability of medical science actively to promote development of these questions owing to absence of the harmonous, logical and finished theoretical base complicate an assessment of the reasons and conditions of causing death on imprudence owing to inadequate

execution by the medical worker of the professional duties, and also development of effective system of the state and public measures directed on their prevention.

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YOUTH EXTREMISM IN THE NORTH CAUCASUS – THREAT OF SAFETY OF THE RUSSIAN STATE

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In article the youth extremism is defined as threat of safety and integrity of the Russian government. Determinants are revealed, some measures of the prevention are defined. According to the author, corruption among authorities is a major factor of youth extremism.

The North Caucasus – one of difficult regions in the criminological plan of the the Russian Federation. Thanks to the geopolitical situation it became the center of the interfaith conflicts, it appeared the favorable region for a wide circulation of the illegal weapon and ammunition among the population. The North Caucasus is a criminogenic zone on level of prevalence of such crimes, as: terrorist act, infringement of life of the state or public figure, infringement of life of employees of law enforcement bodies and military personnel. Generally crimes of a terrorist orientation are committed by persons of youth age.

Absence the of positive of examples for imitation, ideals to which the youth could aspire, promoted revival of subculture of representatives of nonconventional Islam with its "romantic" slogans. At first sight the "noble" purposes of a radical tendency of Islam became a factor of involvement of youth in extremist activity.

Radicalism of youth is characteristic not only for the republics of the North Caucasus. As researchers in many regions of the Russian Federation note, the special alarm is caused by increase in number of aggressively adjusted informal youth associations, including those who put nazi and fascist in a basis of the outlook symbolics. In the last decades there were negative modifications of youth consciousness to prevalence of extremist orientation. In turn, ideological spirit in the youth environment defines the state future.

The youth extremism creates the real threat of safety of the Russian state. Therefore there was a need of creation of reliable system of counteraction to youth extremism at the all-Russian and regional levels. It is necessary to use not a punishment against youth extremism, but also the means minimizing factors, determining this phenomenon. It isn't necessary to forget that the youth in the circumstances in the republics of the North Caucasus can't change the situation. Paramount value has rendering the social help for youth. It is the adjusted, branched, highly professional service having a network of specialized institutions, governing bodies and social security authorities.

Difficult social and economic situation in the regions of the Russian Federation and high unemployment youth radicalizations promote. Owing to criminalization of economy, blasting and devaluation of legal forms of economic activity to socially useful types the number of young people who in modern production, and in life can't find to itself a place increases. Lack of legal forms of earnings for the most part of youth I became an actual problem. But at the same time the external and internal destructive forces, using a socio-political and social and economic situation, manipulate youth in the extremist purposes. Therefore youth involvement in work is one of the social and economic measures of counteraction to youth extremism. «St is necessary improvement and stabilization of a condition of economic system, revival of the state production, production development on the basis of modern technologies, reorientation of the export market with resource and raw on production and industrial, revival in the region the state manufacturing enterprises (plants, factories, collective farms, state farms), deduction of inflationary process within stability of a course, restriction of negative consequences of economic crises, unemployments for has purpose. Work in the state enterprises will give the chance to young people, without losing own selt-tespen advantage and being socially protected, to provide the welfare, to make plans for future».

Unfortunately, neither authorities of local administrations, nor to federal public authorities don't have business to youth in the republics of the North Caucasus. «Politicians and the power structures which are carrying out a country government, turn youth into hostages of consequences of economic and social cataclysms, cause their aggressive and cruel protest movements», without solving in time and in full the problems of regional youth at the state level. And after all «the youth state policy has to be legislatively declared priority at all levels of executive power. Socialization of young generation, ability of the state and its institutors to hold youth from involvement in extremist activity, reasonably to organize system of criminological protection of society from crime and the youth – all this belongs to the most important criteria of a maturity of society, wisdom of its power, stability and reliability, prospects of development of the state».

In reality connivance or active contribution of realization of extremist thoughts of foreign separatists from the bribed authorities of the republics of the North Caucasus push young people to the abyss of the organized criminal communities. Without undertaking efforts on situation improvement, the staff of federal and local power structures destroys young people. It is sad that destruction of youth became one of the ways of enrichment of some authorities and keepers of law.

The explosive situation in the Republic of Dagestan developed because of high level of corruption in all echelons of power. Corruption among authorities, judicial system and law enforcement bodies create the conditions for disorder and republic self-destruction. Political apathy and legal nihilism a the population which have arisen owing to a dissatisfaction with social results and economic change, are factors of negative attitude of the population to power structures. The negative resonance of the population is caused by a gap between the requirements of the right and their realization by authorities. Various categories of the population have an opinion that improvement of a situation in the republic isn't favorable to authorities. It is seldom possible to find the officials "supporting" destiny of the republic, the

people in power structures. Generally the main goal of authorities is own enrichment and improvement of the numerous relatives at the expense of federal grants, beggarly position of teachers, doctors, scientists and other employees. Most sharply negative sides in activity of government officials and employees of law enforcement agencies are felt by young people. Seeing disrespect for laws from employees of law enforcement agencies and other authorities, the youth quite often enters the conflict to the law, is involved in foreign formations of extremist type. The purpose of foreign mafia structures of extremist type is a creation of a criminal situation in border regions of the Russian Federation, violation of its integrity and stability hands of own youth, its ideological befuddling, and also the subsequent destruction of youth by forces of local law enforcement agencies.

One of the directions of counteraction to involvement of young people in criminal communities of extremist sense is traditional religious socialization. The analysis of activity of the religious organizations showed that they play a part in youth socialization. Almost all religious doctrines call the person for good and refusal of commission of crimes and offenses. In this regard it is necessary to accept the nation-wide program for revival and deduction of moral values among youth. Studying of religious morals in the light of modern pedagogics proved need of teaching of moral for schools and for other educational institutions on a religious basis. Such step in education will be able to promote easing of interest to nonconventional currents of religion and the cults which don't have under the historical and cultural soil in the Russian state. Studying of history of religion shows that all mirokvy religions are characterized by uniform essence and continuity of the contents that the original sense of religion is moral improvement of the person and consolidation of the people. Familiarizing with traditional religious culture can serve as some kind of protective mechanism from impact on his reason of religious and mystical and extremist elements.

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FEMALE EXTREMISM IN THE NORTH CAUCASUS AS – EXTREME MANIFESTATIONS OF ACTIVITY OF CRIMINAL COMMUNITIES OF EXTREMIST NATURE

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The article shows that the female extremism is a modern burning issue. The geography of female extremism in the Russian Federation is defined, its determinants are considered. The real research of female extremism has regional character.

In the Russian Federation the extremism gained large-scale and comprehensive character. Most sharply the extremism is shown in such difficult region in socio-political, social and economic, ethnic and confessional relation, as the North Caucasus. Despite a low crime

rate in the republics of the North Caucasus, their geopolitical situation appeared the favorable environment of growth of criminal communities of extremist nature.

Process of massive involvement of women in structures of an extremist and terrorist orientation became feature of this region of the Russian Federation. According to official statistics, in recent years terrorist attacks in regions of the Russian Federation are conducted by women generally. Morever, the analysis and generalization of materials investigation and jurisprudence showed that the female extremism in regions of the Russian Federation "looks younger": the majority of crimes of an extremist orientation is commited by young girls or women of youth age (17–25 years). And, in turn, public authorities are compelled to fight against young women in the North Caucasus.

The researches of scientists and data of official statistics show that if in the nineties of the XX century the Chechen Republic was an outpost of criminal communities of the extremist nature, seeking to construct a uniform Islamic government in the territory of the North Caucasus, now the Republic of Dagestan became the extremist center. As the regional researchers correctly note, the developed socio-political, organizational and administrative situation in this republic actively produces the factors, determining extremism, and the circumstances favoring to realization of the extremist purposes.

Having thrown down a challenge not only to the federal center, but to the national foundations, traditions and values of the population of the republics of the North Caucasus, radical leaders of extremist movements want to turn the Republic of Dagestan on Wednesday of the interfaith, interethnic conflicts by the hands of young people, including young women. As scientists correctly note, activity of criminal communities of extremist nature is provided at the expense of the international and foreign extremist organizations.

The extremism among women in the North Caucasus is used by foreign separatists for situation of destabilization in regions of the Russian Federation. The women of the youth age who got under influence of extremist ideology, aren't capable to normal life and become the tool in hands of representatives of criminal groups. They are often used as suicide bombers, "shahids", murderers religious, public, state, politicians, law enforcement officers.

In recent years extremists and terrorists developed tactics in regions of the Russian Federation of "blind terror", directed not only against representatives of the government and law enforcement agencies, municipal associations, but also against the simple citizens who aren't sharing ideology of radical currents of religion. The purpose of foreign mafia structures of extremist type is a creation of a criminal situation in border regions of the Russian Federation, violation of its integrity and power hands of own youth, its ideological befuddling, and also the subsequent destruction of youth by forces of local law enforcement agencies.

In system of counteraction to law enforcement agencies the major place which is the main force combating this phenomenon, not allowing to pass that side behind which war in regions of the Russian Federation can begin. Therefore tactics of fighters in the territory of the republics of the North Caucasus is systematic destruction of law enforcement officers.

The conducted research established that in the republics of the North Caucasus the female extremism appeared still in the early nineties of the XX century when in these subjects the youth in a mass form left to study in religious institutions of the foreign states, illegal paramilitary groups, criminal communities of extremist nature were freely created, kidnappings and murders of the military personnel, capture of the weapon and ammunition were made. Still in the early nineties of the XX century, under the guise of missionary work, activity of separatists from the foreign states, provided by the legislation on a freedom of worship, using opportunity and incompetence of local authorities began freely developing the promotion across all North Caucasus. The difficult political situation and social and economic crisis in the republics of the North Caucasus became a fertile field for promotion of ideas of extremists.

The martial law in the Chechen Republic had criminal impact on a situation in this

subject. After the stabilization of situation in the next subject of the Russian Federation criminal communities of extremist nature intruded on the territory of the Republic of Dagestan, undermined its stability and tranquillity, trying to involve in war. At the present stage separatists and extremists from foreign countries conduct ideological agitation of the population by slogans about creation of the Muslim state, about office from federation structure, understanding that the Republic of Dagestan is a window to the Russian Federation.

Generalization of materials investigation and jurisprudence showed that behind the facts of involvement of women in commission of crimes of an extremist and terrorist orientation there is a debugged criminal system. Female extremism is created, well prepared, organized and numerous on the structure of the criminal organizations. Extremist structures possess by the nature the high potential of involvement of women in the networks, have special forces, methods and means for development of female extremism. The material power of illegal paramilitary groups financed by the foreign states, promotes involvement of women in a network of extremist communities. It is known that in the territory of the republics of the North Caucasus, in the woods are created subversive and terrorist educational and training camps where young girls, women (wives of extremists, beloved, widows of the lost terrorists) are trained.

For implementation of the purpose of easing of power and integrity of the Russian state foreign separatists bribe in the republics of the North Caucasus of organizers of criminal groups that in the subsequent their participants were engaged in recruitment of new members. The enlisted inhabitants of the republics of the North Caucasus under the influence of extremist structures of a foreign origin carry out active work on selection of young girls for further transformation them to terrorists, "suicide bombers", "shahids".

In recent years the facts of active promotion of ideas of radical Islam among the women serving sentence in establishments of penal system of the republic by persons, condemned for crimes of a terrorist and extremist orientation (the corrective colony for women is located in the territory of the Republic of Dagestan). Now, according to the reached agreement with UFSIN of the Russian Federation on RD, this category of the condemned is transported under guard out of borders of the North Caucasus, for the purpose of an exception of influence on other part of the condemned.

Now positions of extremists gradually become stronger not only in the republics of the North Caucasus, but also in other region of the Russian Federation. In this case the problem of the prevention of extremism among women gains the all-Russian character. Important preventive value on criminological determinants for the purpose of their elimination, minimization and neutralization.

The conducted research in regions of the Southern federal district of the Russian Federation showed that crisis in many spheres of life of the population, first of all in economy became an essential factor of extremism among women. After an economic crisis in 2008-2009 in the sphere of employment there was the difficult situation connected with steady growth of unemployment among women.

The difficult social and economic situation in the republics of the North Caucasus doesn't give youth, including women of youth age, possibility of a choice (workplaces / except free trade aren't created in recent years/, plants and factories aren't constructed, and territories of the existing state enterprises are turned into the markets, are privatized by officials or are rented to the commercial organizations). The results of quiz among various categories of the population show that, unemployment, a low dole, negligent attitude of the state to employment of citizens, low salaries, grants, a difference between rich and poor, the low standard of living of the population and criminal market economy are the factors, determining female extremism.

Connivance or active contribution of realization of extremist thoughts of foreign separatists from the bribed authorities push young people to the abyss of the organized criminal

communities. As scientists (V.A. Burkovskaya, S.U. Dikayev, D.Z. Ziyadova, D.E. Nekrasov, A.V. Rostokinsky) claim, the extremist subculture was imposed to youth, and the state didn't react to this negative properly and therefore some part of youth was assigned to the criminal organizations. The youth became a victim of political and economic interests to please enrichments of certain authorities. Without undertaking efforts on situation improvement, the staff of federal and local law enforcement agencies destroyed and destroys young people. Destruction of young lives became one of ways of enrichment of some authorities and observers of the law.

The conducted research of a modern criminal situation in the republics of the North Caucasus allowed to make the following forecast – further the extremism among women depends on development of economy, social policy of the state, and also system effectiveness of further of this situation.

ABUSES OF POWERS OF OFFICE AND EXCESS OF POWERS OF OFFICE AMONG EMPLOYEES OF LAW-ENFORCEMENT BODIES ARE – A THREAT OF PUBLIC SAFETY

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The article shows crime tendencies among employees of law-enforcement bodies. According to the author, abuses of powers of office and excess of the powers of office made by staff of law-enforcement bodies, are a crime factor. The article also defines determinants and measures of counteraction of crime of this category.

Investigations in various regions of the Russian Federation affirm about to a tendency of growth of abusing of commissions and exceeding workers commissions of law-enforcement bodies which are expressed in violence application concerning offenders, insults of citizens, physical or mental impact on the persons participating in process of a consequence. Detained on suspicion in commission of crime of the person «are exposed not only to mental violence-to intimidation, threats of causing a physical abuse it or to their relatives, but also direct causing a physical abuse». Only the excess of powers of office connected with infliction of harm to health of the person, torture and a beating as R.V. Skomorokhov answers, is most reflected in criminal statistics.

Widespread form of exceeding workers commissions of law enforcement agencies is the shelter of heavy and especially serious crimes from the account. Often the staff of law-enforcement bodies uses the so-called «veiled» forms of concealment of crimes from the account – takes out unreasonable resolutions on refusal in initiation of criminal cases.

Quite often employees of law enforcement agencies commit such crimes, as illegal detention and illegal criminal prosecution. As a rule, such persons are defined without the sufficient bases to that and without registration of the relevant documents. The detained are in call centers, in cameras for detainees, or even in studies of staff of departments of criminal investigation department or investigators.

One of forms of abusing commissions of law enforcement agencies is corruption. As correctly notes T.B. Basova in spite of the fact that fight against corruption is one of the main tasks of activity of law enforcement agencies, unfortunately, the staff of law-enforcement bodies often is involved in this negative phenomenon. As a rule, employees of law enforcement agencies get bribes for release of citizens from criminal, is more rare – administrative responsibility. Among such workers – investigators, local police inspectors, inspectors of GAI

In our opinion, the crimes committed by staff of law-enforcement bodies, create not only conditions for corruption existence, but also provide it. As A.D. Safronov claims, among brought in recent years to trial for commission of malfeasances of law enforcement officers nearly a half was engaged in this or that form by organized criminal groups or separate offenders.

In the Republic of Dagestan special discontent in the population cause universal and daily requisitions and the bribery extended among the staff of GAI. As correctly notes A.N. Gamidov, the staff of this service instead of being engaged in the prevention of violations of the rules of traffic, acts because of shelter, holding observation posts in the places located behind visibility limits of the person, operating the vehicle. Quite reasonable impression is made that it isn't so much important to such employees to warn road accidents, as to find breakers of rules of traffic to extort from them money.

It should be noted high level of latency of exceeding employees commissions of law enforcement agencies. Latency of crimes of such category is explained by that quite often heads of law-enforcement bodies «close eyes» to the crimes committed by their subordinates (such as coercion to evidence; illegal detention, etc.) allegedly for disclosure of more serious crimes; don't wish to worsen indicators of work of the department, etc. As A.N. Varygin and O.N. note Shlyapnikova, often police officers make offenses concerning the persons who have broken the law who are afraid of responsibility, and owing to this fact don't report about the criminal encroachments made concerning them. Besides, many employees, possessing knowledge of criminal, criminal procedure laws, niceties of operational search work, criminalistic recommendations, could skillfully hide traces of the committed crime which as a result remains not revealed.

Factors of abusing commissions and exceeding commissions of law-enforcement bodies are the feeling of the impunity, the insufficient special vocational training, insufficient level of professional culture and sense of justice, absence of specialized psychological services, especially for the persons which have come back from «hot spots», etc. In recent years the police because of events in the republic is turned into «at war police». At the employees participating in fighting operations, «the extremist syndrome» which is expressed that because of the endured stresses all environment is perceived by police officers as hostile is developed so-called. From here both abuses of powers of office and excess of powers of office among employees of law-enforcement bodies.

For prevention of abuses by powers of office and prevysheniye of powers of office among employees of law-enforcement bodies careful check of candidates in a residence, works, studies for the purpose of clarification of their moral and mental qualities is important. It is impossible to admit to law enforcement agencies of persons with the nervous and mental disorders, capable of rough violation of office discipline, a manhandling. For this purpose it is necessary to hold psychological testing of staff of law-enforcement bodies at revenues to service and in its process irrespective of a post. In law enforcement agencies the persons differing not only highly professional, but also moral and psychological qualities for whom law and order protection according to instructions of the law is the main mission of their powers of office have to work.

Prevention of abuses by powers of office and prevysheniye of powers of office among employees of law-enforcement bodies isn't possible without effective system of educational work with them during which it is necessary to form feeling of respect to citizens, their rights and freedoms, to the office debt, to the profession at each employee.

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CRIMINAL POLLUTION OF ATMOSPHERIC AIR – THREAT OF ECOLOGICAL SAFETY

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The article shows the condition of criminal pollution of atmospheric air at nation-wide and regional levels, the factors determining this crime are revealed, some measures of improvement of system of counteraction are defined.

Pollution of atmospheric air by motor transport exhaust gases, emissions of polluting substances in atmospheric air from the enterprises of road economy, oil processing, nonferrous metallurgy and power are among the most substantial negative effects of technogenic changes of environment. That fact testifies to gravity of this problem that over the last 10 years the number of the registered ecological crimes increased more than by 7 times. Among ecological crimes the noticeable place is taken by criminal pollution of the atmosphere though for the last three years only 15 such crimes are registered. As we see, the number is not especially impressive as the conducted empirical research among employees of the state environmental control, law enforcement agencies and various categories of the population show that about 99,5% of the committed crimes in the form of pollution of the atmosphere remain latent.

Studying investigative and legal practise allowed to reveal concrete shortcomings and difficulties of a legal assessment and qualification of actions of the persons guilty of commission of crimes in the form of pollution of the atmosphere. The majority of criminal cases stops without the sufficient bases, retrains on administrative offenses. Especially such picture is observed in regions of the Russian Federation. For example, in Republic of Daghestan the

registered facts of offenses in the sphere of protection of the atmosphere from pollution isn't comparable with a real situation.

At investigation and hearing of cases about offenses in the sphere of protection of the atmosphere from pollution by bodies of the state environmental control, law enforcement agencies and at purpose of punishment by vessels quite often allow unreasonable liberalism concerning the persons who have committed this crime.

If to speak about Republic of Dagestan, here the ecological situation is extremely adverse. Now in the republic menacing scales were accepted by atmosphere pollution by industrial wastes and technogenic emissions. One of the main sources of pollution of atmospheric air is the enterprises extracting oil in the open way from 40 gushing forth wells. Average daily oil production makes 4,2 thousand tons. from which about 200 t. burns out or spreads. The atmosphere in the republic more is polluted by numerous fires on oil development. As a result atmospheric air is densely sated with soot and poisonous gases which are carried by a wind on hundreds kilometers.

The number of existing gas stations (gas station) in the territory of the republic exceeds enough (according to the reference of inspection of traffic safety only in Makhachkala 105 gas stations instead of necessary 12 stations) three times.

According to the bodies exercising the state environmental control, 95% of gas stations are constructed in defiance of existing town-planning, sanitary and hygienic, fire-prevention normative legal acts. The greatest danger is constituted by exhaust gases from use of the non-standard gasoline oversaturated by lead alkyl additives. Specific weight of tests of the atmospheric air, exceeding maximum concentration limit for lead, over the last 5 years on the average on the republic increased more than by 35 times.

The significant role in pollution of atmospheric air is played by motor transport. According to GUPR MPR Russian Federation on RD, its contribution to total emission exceeds 80%.

Pollution of atmospheric air remains one of the major factors of environment making negative impact on health of the population, and first of all causes increase in number of diseases of respiratory organs. In the Republic of Daghestan prevalence of bronchial asthma, bronchitis, rhinitis, pharyngitis, chronic otitis is 40-60% higher in areas with the raised level of pollution of atmospheric air.

The functioning brick-works on the territory of the republic make the essential contribution to atmosphere pollution. These enterprises work mainly at the processing equipment dismantled and exported from foreign countries. On the territory of the republic more than 80 asphalt concrete plants function, concerning each of them is taken out on 2-3 cautions from interdistrict nature protection prosecutor's office of the Republic of Dagestan, with the instruction on a strict violation of the law about atmosphere protection from pollution.

Atmosphere protection from pollution is one of the most important spheres of a state policy. In this regard the Government resolution No. 404 of May 29, 2008 implementation of federal state environmental control behind observance of requirements of the legislation in the field of protection of atmospheric air and the address with waste is entrusted to Federal Nature Management Supervision Service.

The significant role in pollution of atmospheric air is played by motor transport. According to GUPR MPR Russian Federation on RD, its contribution to total emission exceeds 80%.

In pollution of the atmosphere the motor transport continues to take an important place. Danger of motor transport for health of the population is aggravated with that, unlike stationary sources, its emissions are made directly in a zone of activity of the person and create in it high concentration of polluting substances. Emissions of polluting substances from motor transport in RD in 2012 made 156783 t.

In defiance of the legislation requirements, practically any boiler room in Makhachkala has no installations of cleansing of gases and control devices behind emissions of harmful (polluting) substances in atmosferkny air.

The objects most polluting the atmosphere in the Republic of Dagestan are asphalt concrete plants. Employees of Interdistrict nature protection prosecutor's office in common with specialists of management of Federal Nature Management Supervision Service (Rosprirodnadzor on RD) carried out a random inspection of observance of requirements of the nature protection legislation at operation of ABZ located in the administrative territory of Makhachkala. By check it is established that in defiance of Art. 34,35,37,38 of the Act of Russian Federation "About environmental protection", Art. 12,18,19 of the Federal law "About production wastes and consumption" in all asphalt concrete plants are absent drafts of standards of formation of waste and limits on their placement, there are no passports the powdergascleansing installations. However officials don't react to numerous instructions of supervisory authorities. In this regard the author suggests to support the offer of Federal Nature Management Supervision Service on establishment of criminal liability for malicious non-execution by officials of requirements of supervisory authorities.

Source of pollution of the atmosphere also is the unauthorized garbage dump in the southeast of Makhachkala. There is a regular self-ignition that leads to formation of a toxic cloud from polluting substances. Volumes of placement of toxic waste on unauthorized dumps constantly grow. Often branch of the land plots under dumps won't be coordinated, terms of collecting and export of household waste are broken.

The author presents dynamics of emissions of polluting substances in atmospheric air on Republic of Daghestan from 2003 to 2008 the author is presented to atmospheric air in the form of tables and charts.

Detection of features of a condition of crimes in the sphere of protection of the atmosphere from pollution in the Republic of Daghestan, is connected with that the regional crime is produced not simply by the general reasons generating all crime, but also their refraction through the concrete environment of functioning, a combination of special regional distinctions – economic, social, demographic, psychological, etc., characteristic for this region.

Efficiency of precautionary activity concerning considered crimes depends on clearness and constancy of interaction of local governments and the population. Civil control is very significant force in activities for control of offenses in Dagestan. Ecological groups are actively involved in activities for atmosphere protection from pollution.

In many areas of the republic in prevention of crimes well proved public associations, the international non-governmental organizations of the ecological profile, movement of "green" known around the world. One of the forms of participation of the public in fight against crimes in the sphere of protection of the atmosphere from pollution are activities of student's teams for conservation. Besides inspection and propagandistic work, students conduct research work on the interuniversity program "Clean air". Students of natural, mainly biological specialties can competently be engaged in protection of various natural components – faunae, florae, waters, air, etc.

It is expedient to revive institute of inspectors of the All-Russian society of conservation, having conferred them the powers equal on volume to powers, conferred to public inspectors, public inspectors of forest conservation, etc.

In prevention of crimes in the sphere of protection of the atmosphere from pollution numerous government nature protective bodies, including various inspections, control supervision - ные services on atmosphere protection from pollution make the contribution. Their preventive activity would be more productive on condition of an improvement of its financing, due material technical, personnel and other resource providing, strengthening of social and legal protection of employees. Additional opportunities for strengthening of work on

the prevention of ecological crimes and offenses appear as a result of creation in some regions of ecological militia.

In system of the bodies conducting fight against crime in the sphere of protection of the atmosphere from pollution, the special place is taken today by the specialized interdistrict nature protection prosecutor's offices which workers minimize negative consequences, mistakes and omissions in the work of nature protection bodies, violations of the ecological legislation by executive bodies and local governments.

CRIMINOLOGICAL PROBLEMS OF VIOLATIONS OF THE RULES OF LABOR PROTECTION

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The problem of violations of the rules of labor protection is shown in article in various spheres. The author specified tendencies, the factors determining this criminal, act are revealed, some ways of prevention are defined.

One of the priorities of the constitutional state is protection of safe working conditions. According to Art. 37 of Constitution of the Russian Federation, everyone has the right for work in the conditions answering to requirements to safety and hygiene. This constitutional situation which found the specification in other laws and others standard the legal acts, is often violated in the conditions of market economy. And at the present stage of development of economy in the Russian Federation amplifies operation by employers of hired workers, cases of rough violations of the labor legislation are multiplied. And therefore, despite taken measures, level of a industrial injuries remains rather high. Daily on production about one thousand people is injured on the average, from them more than 20 people perish and about 40 people sustains heavy injuries and become disabled people. Thus at the enterprises of the private sector level of traumatism in 2,6 above, than at the state enterprises. Constantly the share of the workers, who are affected by harmful and dangerous industrial factors. Results of the researches conducted by Gosgortekhnadzor of Russia, showed that growth of number of accidents and traumatism cases is noted. So, in 2012 the death growth at the enterprises which are under control of Gosgortekhnadzor of the Russian Federation, for 19% exceeded number fatally injured on production in 2002. By the results received during research, the main reasons of traumatism are: the unsatisfactory organization of a industry of works – 35%; violation of safety requirements of work – 20%; absence of control of safe works – 15%; the admission to work the untrained and incompetent personnel – 12%; exploitation of the faulty equipment and cars without defencive protections – 10%; violation of labor and industrial discipline – 8%. In our opinion, current situation with labor protection is an integrated indicator of the general trouble at the enterprises of the industry, construction, transport, communication and in agriculture, and also decrease in responsibility of heads of all levels for the appropriate organization of production in any field of activity.

Despite the high level of traumatism on production, the violation of the rules of labor protection is among high-latent crimes. Only this way is possible to explain with this circumstance so small number of criminal cases about the crime provided by Art. 143 of the criminal code of the Russian Federation, considered by vessels of the Russian Federation. According to GIATs Ministry of Internal Affairs of the Russian Federation, in 2001 there were 1450 violations of the rules of labor protection, and in 2010 is three times less – only 558 1

In the last years and in the Republic of Daghestan the tendency of growth of violations of the rules of labor protection is noted. The situation with labor protection in the republic

distinctly is characterized by statistical data on traumatism of people. According to operational data, in the Republic of Dagestan in 2012 on production 25 people perished, 142 are hard injured. In 2012 from the accidents which have happened on production, 780 people suffered from whom 25 from traumatized died. The analysis of figures shows that the greatest number of cases of traumatism is the share of the production sphere (482 persons). However cases to a deadly outcome in 2012 happened more at the industrial enterprises. The similar situation and in the agricultural enterprises for RD, so from 107 victims in this branch 6 people were lost. However, the number of the brought criminal cases about these crimes is insignificant (1997 – 2; 1998 – 1; 1999 – 2; 2000 – 3; 2001 – 3; 2002 – 6; 2003 – 2; 2004 – 0; 2005 – 5; 2006 – 6; 2007 – 3; 2008 – 5; 2009 – 2; 2010 – 2; 2011 – 2; 2012 – 3) in comparison with the found facts of violations of the rules of labor protection.

By research it is revealed that the main reason for discrepancy of quantity of violations of the rules of labor protection and criminal cases is that such crime committed by the official, is in essence one of types of excess of powers of office. Such crimes are committed in real set with abuses of powers of office and often are registered as malfeasances. Generally the persons who have made violation of the rules of labor protection, are disciplinary punished.

On the basis of the conducted research it is revealed that the most widespread violations of the law about labor protection at private enterprises of the Republic of Dagestan are: non-inclusion in collective agreements of the obligation employers on improvement of conditions and labor protection of workers, including women and youth (Labor of Russian-Federation Art. 41); un carrying out acquaintance of workers with labor protection requirements (the item of 20 h. 2 Art. 212 of Labor Code of the Russian Federation); insufficient financing of activities on improvement of conditions and protection work in the organizations (Labor Code, the Russian Federation Art. 226); violation of requirements of the law on prohibition of application of work of women at the works connected with rise and movement manually of weights, exceeding maximum permissible norms for them (h. 2 Art. 253 of Labor Code of Russian Federation); violation of requirements of the law on a prohibition of carrying and movement by workers eighteen years old of the weights exceeding limit rates established for them (h. 2 Art. 265 of Labor Code of the Russian Federation).

The conducted research showed that in an inadequate way work on control of performance of the legislation of the Russian Federation on labor protection of minors is organized. The special alarm in this direction is caused by application of work of minors at gas stations, car washes and in other spheres.

Conditionally the circumstances promoting violation of the rules of labor protection, according to the classification accepted in criminological literature, may divide on social economic, political and social psychological, i.e. the reasons of commission of a considered crime carry both objective, and subjective character.

The economic crisis of last years and recession of economy were adversely reflected in state of conditions and labor protection. During crisis in many enterprises rules of labor protection are ignored.

Studying of criminal cases and negative materials on the facts of violations of the rules of labor protection showed that these acts don't receive a due legal assessment and response to them from law enforcement agencies and bodies of the state supervision and control of labor protection. In certain cases investigating authorities and courts don't take measures for criminal prosecution of all persons guilty of criminal violation of the rules of labor protection. It leads to that the principle of inevitability of responsibility for the committed crime isn't observed. Practice on cases of violation of the rules of labor protection shows that about 80% of the criminal cases brought on the facts of accidents, stop at a stage of preliminary investigation. The remained affairs submitted for consideration of vessels, come to the end or appointment to the defendant of the punishment which hasn't been connected with imprisonment, or release of

the person which has violated rules of labor protection, from criminal liability. In this regard violation of inevitability of criminal liability is one of essential factors of violations of the rules of labor protection. Research showed that disciplinary, administrative, civil actions of influence for offenses in the field of labor protection aren't fully used. At the same time only complex use of criminal and legal, civil and other means of legal regulation will allow to carry out an execution of the punishment and to provide due preventive and right recovery effect.

Prevention of criminal violations of the rules of labor protection represents system of versatile measures for prevention of the crimes which are carried out by various subjects (state and non-state, specialized and unspecialized), by identification and elimination (blocking, neutralization) the reasons and conditions of crimes.

The special role in prevention of criminal violations of the rules of labor protection is played by legal measures. As priorities on improvement of a legal basis of labor protection the author allocates: 1) development of the concept of legal support of office and operational activity on labor protection; 2) stimulation of development of system of counteraction by adoption of laws and other regulations directed on improvement of preventive norms; 3) creation of a legal mechanism of realization and organizational and technical ensuring activity of supervisory authorities in labor protection questions.

In system of legal measures of prevention of criminal violations of the rules of protection the important place is taken by the criminal legislation. Establishment of criminal liability for violation of the rules of protection is caused, first of all, by the actual adverse situation in the sphere of providing the favorable working conditions, to menacing life and health of citizens. Criminal and legal funds have to be allocated mainly for fight against the organized official crime in the labor protection sphere. During the study of crime and development of means of fight against it great theoretical and practical value is gained by the correct assessment of efficiency of application of these measures.

The registered crimes and the revealed persons in 2001 and 2010 in a section of articles of special part of the criminal code of Russian Federation (Extraction from forms 1 of Gui and 1-EGS)//the Annex to the book "Crime, its types and fight problems. Under the editorship of A.I. Dolgovoy. M, 2011. – P. 357.

MODERN TRENDS OF INVESTMENT: MACROECONOMIC ANALYSIS, MODELING, REGULATION

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Increasing management effectiveness of the investment process involves the necessity of providing of informational and analytical and intellectual support to decision-making based at the preliminary macroeconomic analysis and modeling processes of the functioning of the multisectoral macroeconomic system in the conditions of interaction of macroeconomic markets taking into account the balance in financial expenses and income sectors of the economy. Keywords: investment, macroeconomic

Modernization of the Russian economy, the development of new technologies, high-technology industrial production is impossible without effective regulation of the investment process on the macroeconomic level. Increasing management effectiveness of the investment process involves the necessity of providing of informational and analytical and intellectual support to decision-making based at the preliminary macroeconomic analysis and modeling processes of the functioning of the multisectoral macroeconomic system in the conditions of

interaction of macroeconomic markets taking into account the balance in financial expenses and income sectors of the economy. Investment process in the Russian economy is characterised by the following trends over the years of formation economic system with market relations. First, a trend of an increased degree of the wear of main funds, which suggests that investments in fixed capital. Thus, the depreciation of fixed assets at the end of 2010 amounted to 47,1%, which is the highest value over the past decade. For exception of a number of sectors (trade, financial activities) the main funds in the majority of sectors of the national economy are worn out by more than 40- 50 %. Refresh rate of intensity of process renewal of fixed assets, due to the economic crisis of 2008 fell to 4.1% in 2009, in 2010 decreased to 3.9 % (in 2008 it amounted to 4.4%). Negative dynamics of the coefficient of renewal that characterizes the investment sphere and reproduction processes in the the economy indicates a considerable deterioration of the state of the investment sector.

Secondly, in the period of economic growth of the Russian economy for export-oriented scenario (2000-2008) was observed the trend of moderate growth of investments with an annual rate of 10-15%, the growth was driven mainly by growth of private investments 26 investors, while the share of the state in the structure of investments significantly decreased. However, despite the growth of capital investment, the existing age structure of the fixed capital, its physical and moral wear, observed growth of investment is insufficient to implementation of the effective renewal of basic production assets and the modernization of the economy [1;67]. In connection with the crisis 2009-2010 the value of investments in Russia fell by nearly 17% compared with previous periods. Thirdly, in Russia continues to remain unfavourable that is the result, on the one hand, the current for decades the structure of the economy, due to which the larger sectors have a relatively large sources of own funds for accumulation with other formed in the profitability ratios production and dynamics of prices, respectively orienting investments.

Lagging behind many countries in size and share of gross, Russia in the same time a little concerned about the direction of investments in the industry, ensure the increase of technological level of production. Their share in the accumulation of remains negligible. So growth of investments in fixed capital of manufacturing industries for the first quarter of 2012 was slightly lower the General growth of investments in them sent only 18.5 % of the the total volume of investments in different economic activities. Fourthly, there is a tendency to preserve the large gap between savings (savings) and investments of approximately 10% of GDP. The investment potential is not fully demanded, talking about the formation of sizeable reserves funds, which accumulate natural and price rent. At the same time the tendency of development of the liquidity deficit on the domestic market, which leads to a decrease in liquidity of the Russian banking system and, as a consequence, to the expansion of borrowing on world markets. Fifthly, this is a high level of openness of the Russian economy regarding the cross-border capital flows, which is due to the current model of integration of Russia into the global economy. With one hand, there is an increasing flow of foreign investment in Russian enterprises. On the other hand, there is an active export capital highlighted, in particular, the unfavourable investment climate and the low quality of public institutions. The consequence is the growth of interest rates, significantly exceeding the world level in the amount of 2%-5% [2;28].27 All these trends to the investment process in Russia proceed against the background of raw material export orientation of the Russian the economy, which is the cause of many of them. One of the main disadvantages of raw material export model the economy is the lack of capacity of the economy to withstand the adverse effects of the economic situation, which, as a rule, connected with price fluctuations on the world market of natural resources and lead to fall in production in the primary sector, other production sector cannot support the economy because of technical and technological backwardness. These features determine the relevance of study of the investment process.[3;90] the Features of this the study determined that the investment process is considered, first, at the macro level; secondly, in close relationship with

reproduction process of shaping the macroeconomic circulation of financial and material flows, and, thirdly, in the aspect maintain desired reproduction proportions describing the branch structure of the real sector of the economy (its structural aspect ratio).

The investment process is the Foundation for the development of economy and characterized by a large number of functions and parameters; the complexity of behavior, the presence of competing parties; continuous communication interacting elements of the system in the form of certain patterns; the reflection of views, goals and values of the subjects of the of management. The investment process, multi-sectoral macroeconomic it is inherent in the system dynamics, which is necessary category at the analysis of macroeconomic processes and plays a decisive role in their management. Main source of information for the analysis of data are national accounts of Russia, because they are in a systematic form characterize all the main parties in the process of reproduction: the volume of goods and services created for the end and intermediate consumption, stockpiling and export; structure of production; contribution to the cost of production made at the enterprises, by types of activities and sectors of the economy during a specific period. the volume of primary incomes received by economic agents; the process of redistribution of income and their использование.28 Solution of problems of the analysis and management the investment process on the macroeconomic level is executed by the development of software and modeling complexes and systems of intellectual decision support solutions. Application of intelligent systems design and support decision-making is advisable to assess the socio-economic provisions and development of scenario conditions for functioning of the economy that serves the purpose of increase of efficiency of functioning macroeconomic systems and can increase the degree of scientific the reasonableness of management decisions taken at the state level[4;78].

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