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LOGICAL AND STATISTICAL INFORMATION MODELS AND PROSPECTS OF THEIR USE FOR STATE DIAGNOSIS OF THE OBJECTS OF BUDGETARY INSTITUTIONS ACCOUNTING

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Purpose. *The purpose of the article is to justify expediency and to develop theoretical and practical principles of logical and statistical information models application for the purpose of state diagnosis of the objects of budgetary institutions accounting.*

Methods. *During the research process were used: techniques of systems analysis, graphical method and the method of scientific abstraction (to form vector parameters of financial provision by different scenarios), synthesis and mathematical modeling (in order to develop formal presentation of LSIM description (logical and statistical information models), setting allowable limits of financial provision and development of control (diagnosis) block diagram of objects state accounting), method of comparative estimation (to establish the usefulness of different types application of LSIM (logical and statistical information models) in the system of budgetary institutions accounting).*

Results. *Expediency of application of logical and statistical information models for diagnosis of objects state accounting was substantiated. The principles of modeling of logical and statistical models of financial provision of budgetary institutions activity were developed. Description of features was made and graphic schedules of LSIM (logical and statistical information models) modifications for accounting objects were built. A block diagram of the automation control of objects state on the basis of LSIM (logical and statistical information models) accounting was made for budgetary institutions. A model of the signal result document taking into account the financial and non-financial features of budgetary institutions accounting and specifics of the result parameters of appropriate inference of states control by using LSIM (logical and statistical information models) was developed.*

Scientific novelty. *A new approach to building a system of budgetary institutions accounting with an emphasis on the use of logical and statistical information models for accounting objects diagnosis (control) was offered.*

Practical significance. The obtained results allow to improve the quality of management system, help to strengthening its role in ensuring the efficiency of the information preparation for administrative decision-making.

Keywords: public institutions, accounting system, accounting objects, logical and statistical information models, financial provision, criteria, states control, block diagram.

Statement of the problem. At the present stage of development the problems of providing the resource potential optimization of activity subjects are extremely actualized. One of the most effective and high-speed systems, which can provide unbiased operative information for the purposes of management is computer form of accounting. However, despite its absolute progressivity and availability of numerous advantages in domestic practice its drawback is insufficient analytical control ability. Accordingly, the purpose of the study is to assess the issues and factors impeding the implementation of computer technology increased use in order to perform analytical procedures and tests of accounting data and summarize the principles of accounting modernization and their impact on description models and source types of accounting information. The thesis that during past years (since 2011) business-analytics technologies are very popular, and their purpose is accelerating the management decisions adoption, providing the best activity option and resource potential use, strengthens the need for such approach [6, p. 251-252]. Forming an effective alarm system, integrated in the accounting system for the provision of operational management of accounting objects at budgetary institutions, is rather actual. Just from technical position, this approach can be positioned as a diagnosis of accounting object state in the context of its accounting reflection. Parameters of such diagnosis would be expressed by certain quantitative parameters. The simplest example of such a diagnosis is recognition of emergency and pre-emergency states of complex industrial facilities. Regarding the accounting objects, use of a similar practice also seems to be appropriate, since it will facilitate efficient resolution of issues of financial and material provision, and also the rational organization of the process service provision in general.

Analysis of recent research and publications.

In order to develop the accounting systems, which can provide monitoring of critical states of its objects, first of all it's necessary to give their definitions. As it was pointed out concerning the objects accounting of budgetary institutions, there is no such research at all at present. Mainly the problematic of diagnostic of management objects state is systematically examined by the scientists technical sciences branch in order to create or improve information management systems of complex objects. Particularly in this area investigations were conducted by such scholars as I.V. Andrushko, MI

Huchii, V.P. Zinchenko, J.M. Nykolaichuk, I.R. Pitukh, S.S. Fraier, N.H. Shyrmovska, B.M. Shevchuk and others. The relevance of such studies is dictated by the need to prevent accidents and control of technological processes in order to keep them in the right conditions (modes), because of this, at least, number and quality of manufactured products, and in more global scale - social security depends.

In general, scientific publications pay their attention mainly to forming of the fundamental principles of the technical component, which is able to carry out states control of complex industrial systems. In this context, some scientists call diagnosis of the state of management facilities the task of situational analysis, i.e., by determining the set of managed staff situations of complex systems and prognostication of probable extraordinary situations and emergencies during its operation [2, 11]. J. M. Nykolaichuk and N.H. Shyrmovska indicate that the experience of developing theoretical principles of diagnosing of management objects (MO) state shows that pre-emergency and emergency states tend to occur when the object moves in a quasi-stationary state due to failures of technological equipment, technology process violation etc. [9]. These authors, making development of methods of identification of pre-emergency and emergency states of management object note that this task is characterized by several features of the following character: the object in normal state, usually is described by stationary characteristics; the object that goes into the pre-emergency state, is identified by jumps of some characteristic functional parameters, corresponding to quasi-constancy of its statistical characteristics; the object that moves in emergency state is mostly described by the drift characteristic of almost all functional parameters, significant change of matrix coefficients of mutual correlations and instability of statistical characteristics [10, p. 35].

These features are taken into account during forming of systems that can promptly identify the functional states of the production environment, which go beyond the normal limits. In the final version such systems should prevent failure, destruction of the object, or output (production) of low-quality end product. However, the approach based on the principles of applying innovative methods of diagnostics of control objects states, can be effectively used in the creation of accounting system of activity subjects, since it will enable timely detection of critical states of accounting objects and will avoid malfunctions in their use. This is especially important in terms of resource shortages and increased competition, including in the fields of public sector at services rendering to population by the subjects, which are financed from the state budget.

Task setting.

The process of services rendering by the budgetary institutions, particularly by medical and educational institutions, can be included in the complex objects of management. Accordingly, its consideration from the

position of accounting organization, as the basis for this process managing, should include the questions aimed at functional improvement of information accounting data and provision of efficiency of their consideration for continuous work. One of the most effective ways to achieve this task, as it was already proved, is diagnostics of accounting objects state in order to keep them at an optimum level. From this position, the state of the management object can be defined as the state that is identified by the accounting system according to the specific, clearly defined mathematically-expressed parameters. The disadvantage of the present system of budgetary institutions accounting in this regard is insufficient functionality and low information content of the data, due to the static test parameters of accounting objects. In most cases, in relation to them you can not apply the methods of amplitude measuring of monitored parameters, even though at low and short-term deviation from the norm, such as the delay of the funds transfer (financial provision of activities), serious obstacles in the organization of service rendering may occur. It becomes clear especially, when due to the under-funding a budgetary institution is unable to pay for public utilities. With appropriate technical capabilities, the services suppliers may apply concerning budgetary institutions such key factor as disconnection of gas supplies, electricity and so on. In winter period it completely eliminates the possibility of services providing by budgetary institution. Provision of these situations preventing by accounting system, including through timely detection of deviations from the norms of assets and funds expenditure, will help to stabilize the activities and to achieve the mission of quality services rendering and budgetary savings. Accordingly, the purpose of this article writing is to form the reasoning of expediency of application of logical and statistical information models in order to diagnose the accounting state of budgetary institutions objects, including financial provision. According to the set goal in the research process you should ensure the following tasks solution: to summarize the theoretical principles, to formalize descriptions of logical and statistical information models of diagnostics of accounting objects states on the concrete example and to build a block diagram of forming of accounting document - the result form of evaluation of the accounting object state.

Statement of the main research material.

Modern scholars and practitioners suggest that in the market conditions the issues of data detailing to analyze deviations of actual results from planned (or most appropriate) results become actual [10]. The task of this analysis is prevention of failures, unexpected expenses, and also provision of optimization of budgetary institutions activity in general. The opportunities of ensuring of this problem solving correspond to the conditions of use of logical and statistical information models (LSIM), which in terms of computerization can be realized by using the appropriate software.

Methodology of different classes of logical-statistical models enables to control different kinds of deviations from defined parameters of the object in dynamic mode [1, 4, 5, 8, 12]. Today, at least seven known logical-statistical models, which can be used to calculate deviations from the norm of the state of different accounting objects. In the early stages of improvement of accounting systems on their basis it is advisable to diagnose basic facilities, which include financial provision volume, income and expenses, and later on - inventory and fixed assets, payments etc. It is well known, that the main object of accounting and term of business activity by budgetary institutions is financial provision amount. Application of LSIM (logical and statistical information models) - the approaches for the implementation of their assessment and forecasting, is an important condition for preventing the crisis states and provision of their efficient elimination, through taking the appropriate management decisions [5, 6]. Theoretical evaluation of the proposed logical and statistical information models, allows to suggest that the most appropriate for monitoring (in conjunction with analysis) the state of accounting objects, including financing of budgetary institutions, are the following: LSIM (logical and statistical information models) 1 - by amplitude, LSIM (logical and statistical information models) 2 - by dynamics, LSIM (logical and statistical information models) 3 - by phase.

The purpose of the first LSIM (logical and statistical information models) is to reveal (identify) deviations of assignments income volume by amplitude. At the same time setting of allowable norm limits, within which it is advisable to keep the volume of financial provision for the normal functioning of budgetary institution, should be calculated as follows: a) the lower limit (Fik_{min}):

$$(Fik_{min}) = (F1min + F2min + F3min) \times Ii / 3, \quad (1)$$

where $F1min$, $F2min$ и $F3min$ – accordingly: minimum monthly amount of financial provision for the previous three years;

Ii – the average inflation rate for the last three years;

b) the lower limit parameter (Fik_{max}):

$$(Fik_{max}) = (F1max + F2max + F3max) \times Ii / 3, \quad (2)$$

where $F1max$, $F2max$ и $F3max$ – accordingly: maximum monthly amount of financial provision for the previous three years. The substantiation of data choice for the previous years is invariability of methodology of calculation of financial provision volumes, and control of inflation index allows you to bring these parameters to the actual cost estimates.

Also there may be used other approaches to establish maximum limits, namely: according to their independently established oriented and acceptable limits, calculated according to their own technique; reasoning from the achieved minimum and maximum levels of monthly financial provision of similar subject, which has better performance; due to the standards, established by the state. In general, the model of financial provision offered by LSIM

(logical and statistical information models) is described by the vector of Boolean variables [5, c.98] and takes the following form:

$$Ll = \{f_1, f_2, \dots, f_m\}, \quad (3)$$

where m – dimension of the sample (in this case, it is 12 parameters of funding, reflected in the accounting system for each month of the year).

Observation of financial provision performance is reasonable to carry out during certain period of time. Since it is carried out monthly basis during the year, this is the very time period, which should be selected for the study. During this time interval the sequence of vectors is formed that characterize the amount of revenue at each discrete moment. A value of Boolean variables is defined by the following condition:

$$f_{i_k} = \begin{cases} 0, & \text{npu } F_{i_k} \in E1_i; \\ 1, & \text{npu } F_{i_k} \notin E1_i, \end{cases} \quad (4)$$

where F_{i_k} – amplitude value of the financial provision in i - month (if necessary, you can select the time period shorter or longer than it (e.g. weekly or quarterly)); k – discrete time system; $E1_i$ – tolerances aperture of financial provision in i - moment.

It should be emphasized that the use of the first LSIM (logical and statistical information models), taking into account the existing features of the financial provision, may have several versions. They are shown on the diagrams as going beyond the established limit values and demonstrate excess of volumes, or, alternatively, institutions under-funding. The accounting data, which characterize financial provision volumes and corresponding aperture are described for determining vector coordinates by these conditions (2) (formed for accounting the object according to [5, p.99]):

$$f_i = \begin{cases} 0, & \text{npu } M_{F_i} \in E11_i; \\ 1, & \text{npu } M_{F_i} \notin E11_i; \end{cases} \quad f_i = \begin{cases} 0, & \text{npu } M_{F_i} \in E12_i; \\ 1, & \text{npu } M_{F_i} \notin E12_i; \end{cases} \quad f_i = \begin{cases} 0, & \text{npu } D_{F_i} \in E13_i; \\ 1, & \text{npu } D_{F_i} \notin E13_i, \end{cases} \quad (5)$$

where the first term provides evaluation of selective mathematical expectation, the second one - of sliding mathematical expectation, the third one - evaluation of the variance.

The advantage of the considered modifications of LSIM (logical and statistical information models) is insensitivity to some random deviations of financial provision parameters, integrated sensitivity of the model and reduction of data volume.

Figure 1 shows the hypothetical examples, reflecting the principle of forming of Boolean variables in the first LSIM (logical and statistical information models) and its modifications for the assessment of the financial provision state, which is the object of budgetary institutions accounting.

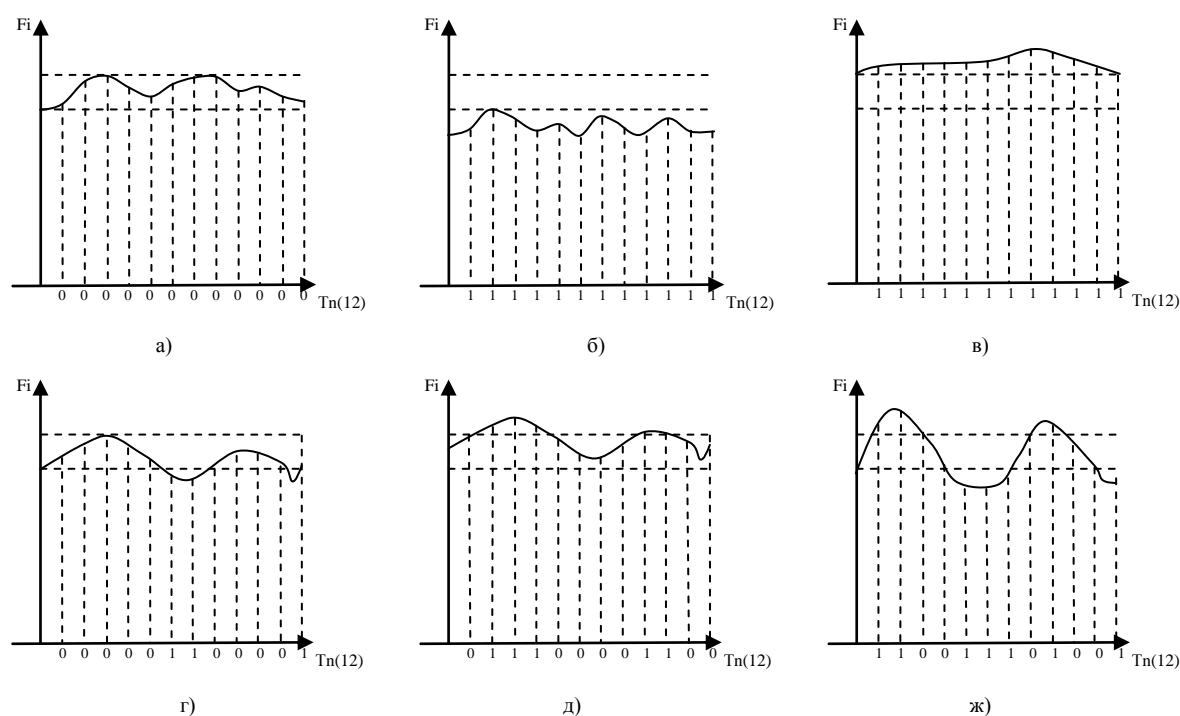


Figure 1 – Types of forming of the vector values of financial provision according to the first LSIM (logical and statistical information models) due to different scenarios

Symbols: a) financial provision within norm limits; б) insufficient financial provision; в) excess financial provision (hypothetically); г) financial provision of „norm + insufficiency” type; д) financial provision of „norm + excess” type; ж) financial provision of „excess + norm + insufficiency” type

Some depicted modifications of LSIM (logical and statistical information models) 1 are characterized by hypothetical vector of financial provision (e.g., c, e, f). At first sight, it appears that in practice such cases, which are illustrated on Figure 1, practically never occur. This is to the contrary of the specifics of treasury services of budgetary institutions, excluding the assignments provision in amounts that exceed the assets, planned by calculations. However, the feature of the recommended approach is not so much monitoring of compliance with established limits of financial provision, as construction of accounting system, which is able to provide its maintenance on optimum permissible levels, acceptable to render services in the amount, which corresponds to the intended efficiency of budgetary institution functioning. That is given examples of modifications of LSIM (logical and statistical information models) 1 are the basis for further substantiation of signaling module forming of the accounting system, which is based on diagnostics of the accounting object. In more practical formulation, the last of them (f), is detailed below (Figure 2 and 3). In this case, the basis is the specific situation, taking into account the amount and frequency of financial provision allocations of budgetary institution.

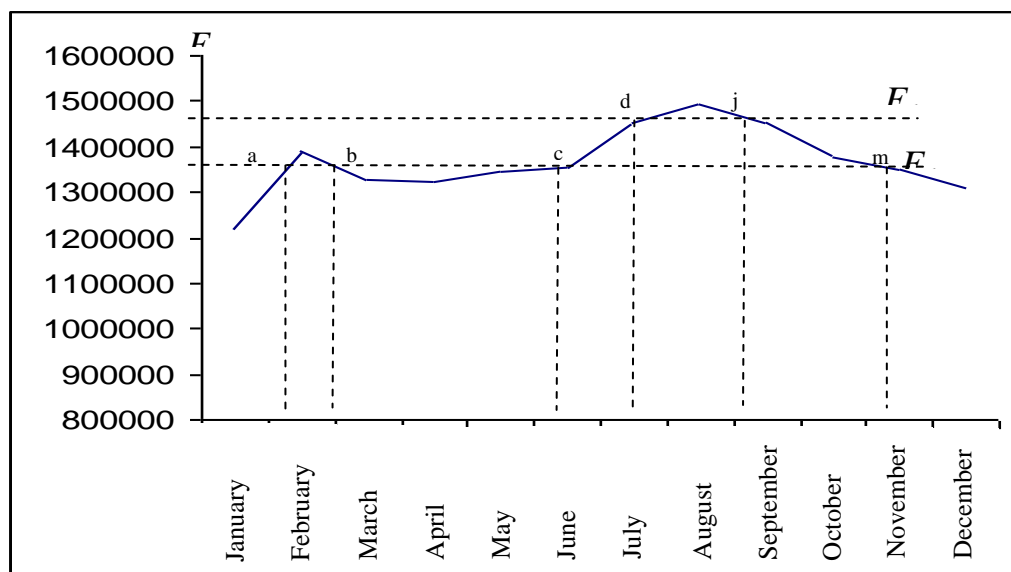


Figure 2 – Forming of values of the vector of monthly financial provision

Function diagram of financial provision, built on the basis of actual data, indicates that at certain periods of time variations in amplitude functions from the limits of acceptable standards is available. Such deviations are observed at the beginning of February (a) and March (b), in the middle of June and July (c, d), at the beginning of September (j) and in the middle of October (m). Thus, the interval chosen initially at the level of one month, does not allow conducting qualitative assessment of financial provision of more specific interval. Therefore, study of the function of financial provision in the context of one week is substantiated (Figure 3).

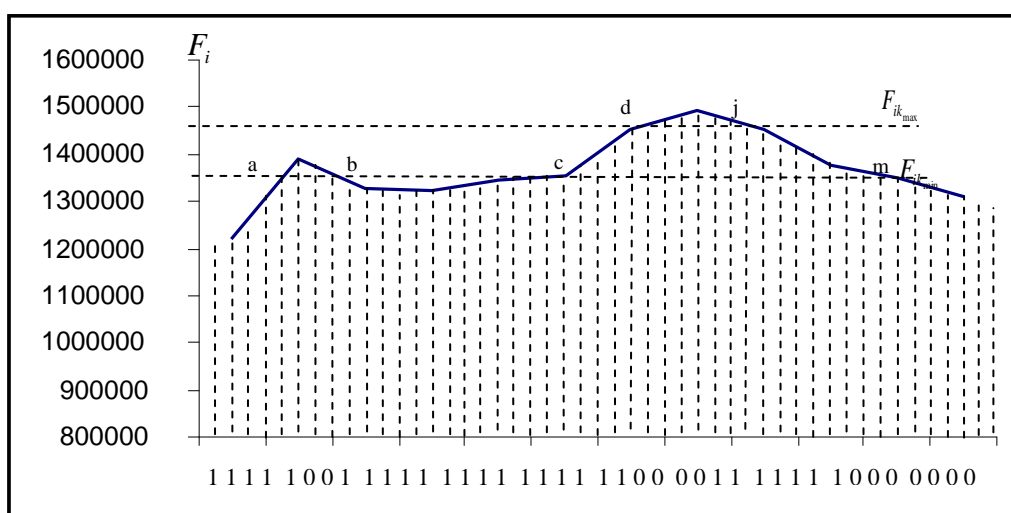


Figure 3 – Forming of vector values of financial provision according to the first LSIM (logical and statistical information models)

As the illustration of criteria of the first LSIM (logical and statistical information models), given on the Figure 2, 3 in the points of diagram going beyond the established limits of financial provision volume, shows, the function obtains the value 1, and being in the optimality zone (from $F_{ik_{min}}$ to $F_{ik_{max}}$), it is equal to 0. Thus, the revealed deviations is advisable to withdraw as an alarm accounting register ("Financial provision according to the estimate" or as "Operative internal report on the diagnosis of accounting object state") with the presence of the column "Critical deviation", in which deviation from the standard should be marked with a specific sign in red (e.g., "Danger" or "Recommended measures").

In the future, taking into account the specifics of the budgetary sector subjects and the purpose of obtaining signal information, which is to prevent possible problems, especially at financial provision vector entering below the lower limit value, it is necessary to conduct more detailed data analysis. The importance of the offered approach is that detailed analysis is carried out not by all parameters, but only by those, which run outside the limits of optimality zone. This reduces greatly the amount of information data, needed to be analyzed. Besides, the use of LSIM (logical and statistical information models) allows to control the volume of financial provision for each period of time, keep it within certain limits and to ensure the most optimal correlation through appropriate management decisions taking.

Using such approach to the assessment of the accounting object (in our case, the volume of financial provision) will give opportunity to prevent critical situations and to regulate the situation regarding provision of its location within the normal range by applying appropriate management levers. The management and the officials of different management units will be notified automatically about critical volumes of accounting objects. At the same time different signaling approaches can be applied, namely, forming of a paper signal document with digital data, or showing an icon at opening the corresponding accounting document (that is primary documents, cards of analytical accounting, etc.), which would indicate a danger (this may be the icon of "exclamation point" (or the initial letter of accounting object name) on the red background).

After its appearance an accounting employee will be obliged to make a transcript of accounting data. For this purpose he can print or send appropriate information to the responsible management employee. The block diagram of automation of forming the efficient form will include the following elements as switching on the control, selection of LSIM (logical and statistical information models), making a management request concerning the control the criticality of accounting object, etc. (Figure 4).

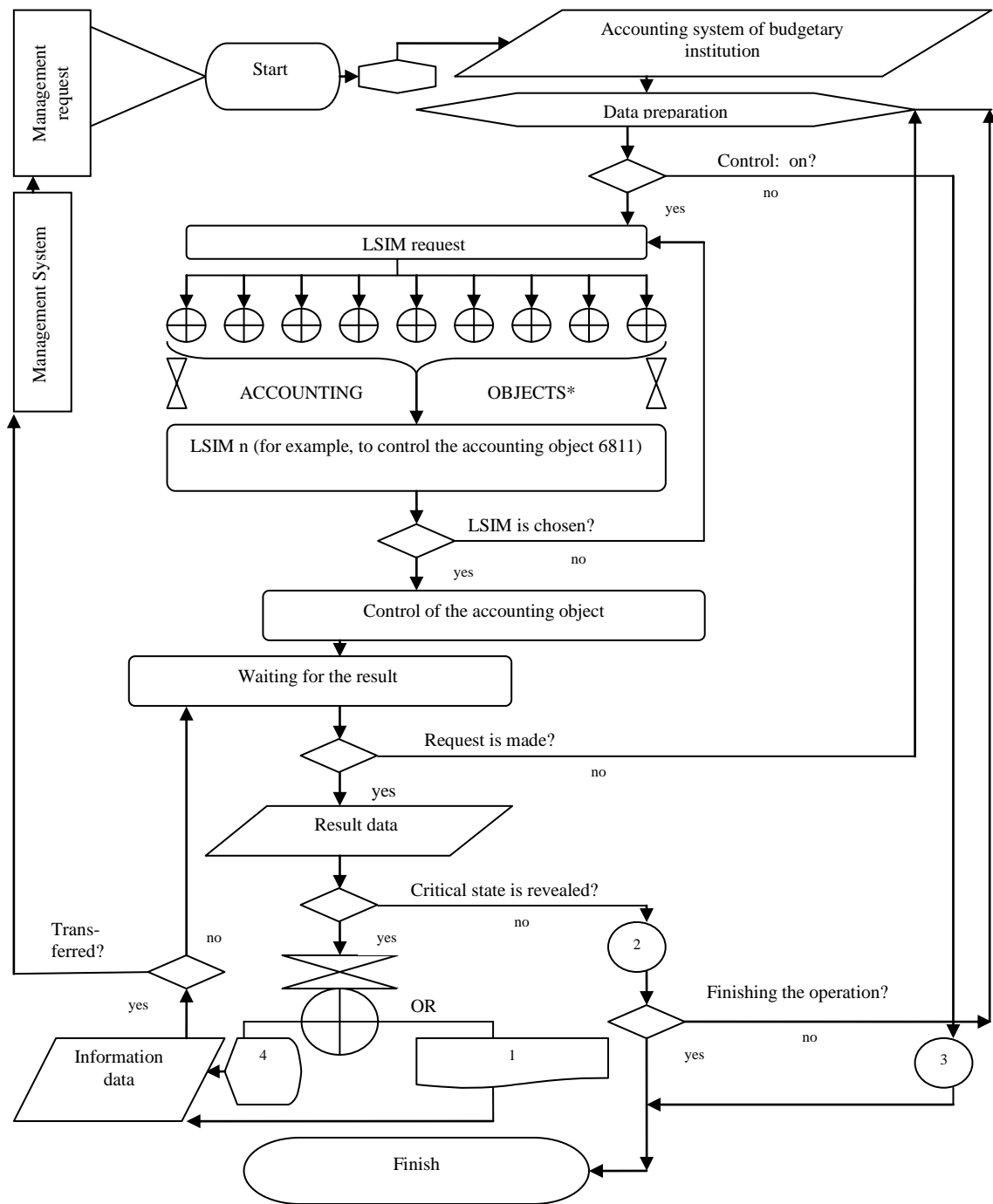


Figure 4 – Block diagram of control of accounting objects state on the basis of LSIM (logical and statistical information models)

* due to the account code (6811 – provision of compensation of further (future) expenses; 1 – signal document (form, proposed below); 2 – media error (source of accounting information); 3 – abolition of control; 4 – display.

Block diagram, developed and formalized on Figure 4, covers completely all accounting objects, however, by the decision of management and depending on the efficiency level, which will ensure its application, you can select only the main controlled objects. For each type of object, depending on the specifics, parameters and volume of services rendering, critical limits (aperture) LSIM (logical and statistical information models) should be

established. An example of their forming concerning financial provision is given above. More profound substantiation and development of these limits can serve as an actual direction of scientific research.

Taking into account the need for signal efficient document, further task of scientific research is creation of its general layout. Taking into account the features of accounting objects of budgetary institutions and the specifics of output of efficient parameters of their states control using LSIM (logical and statistical information models), it is recommended the form of a document, which includes the ability to display the financial and non-financial monitoring results (Table 1).

Table 1 - Recommended form of the result document

(date) _____												
Operative internal report of diagnosis of the accounting object state*												
_____ (name and place of accounting object)												
a) financial assets												
Accounting code	Planned sum, UAH			Actual sum, UAH			Deviation, UAH			Risk level (cipher of risk code)	Recommend measures	
23130nnnnn	13475232,45			13475232,45			–			0	–	
231300nnnn	3732852,37			752882,37			2979970,00			max	Stop of usage	
2313000nnn												
...												
b) no financial assets												
Accounting code	Location	Planned parameters			Actual parameters			Deviation			Risk level (cipher o risk code)	Recommend measures
		quantity	price	total	quantity	price	total	quantity	price	total		
...												
Responsible person _____												
(Surname, name, patronymic / signature)												
Contact person of management system _____												
(Surname, name, patronymic / signature)												
Kind (channel) of communication _____												
(electronic (give electronic address), ordinary (transfer from hand to hand), by post etc.)												

Possible option of presenting of monitoring results of subjects accounting state of budgetary institutions with the help of LSIM is also schedules building with their automatic display on the screen at accounting system running. This approach will enable timely detection of critical states and create operational measures to bring them to a norm.

Conclusions and prospects for further research. The proposed approach to creation of the accounting system that could provide information about the critical states of financial provision volumes based on application LSIM (logical and statistical information models) is an important tool of system

control of this object of budgetary institutions accounting. Use the recommended approach will allow to conduct continuous monitoring of the studied accounting object and to eliminate obstacles due to managerial influence on its condition. Taking into account the emphasis of the modern management system of budgetary institutions on ensuring the optimization of their activity, a similar system is feasible concerning such accounting objects as costs and revenues, as well as stocks.

Receiving the information about the dynamics of objects state in time or during particular time period is of no less important for the control system. Such accounting information is necessary to evaluate trends of resources use, identification of seasonal activity availability and its influence on effective performance, optimization ensuring of the volume of accounting objects with activities volume etc. In this context, it is useful to use the second and the third LSIM (logical and statistical information models), which formal description concerning the accounting objects requires implementation of appropriate scientific generalizations.

The feature of LSIM (logical and statistical information models) use with the purpose to diagnose accounting objects, as opposed to management facilities (technological processes) is the need for shaping not just the information about deviations as such, but receiving their parameters data, including negative and positive. Solution to this problem is possible by applying the appropriate method of object states coding, which also requires research and is a promising direction of scientific research.

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