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Development of an information system for monitoring the process of achieving strategic goals

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Abstract. The automation of the process of identifying deviations and controlling key indicators is an important step in planning and implementing corrective and preventive actions to ensure the stability of the process of achieving strategic goals. The analysis of detected deviations is a multi-step procedure aimed at studying interrelated random events and processes within the considered class of complex dynamic systems (CDS). The reliability of deviation identification depends on the methods of their detection, observation methods, formalized representation of parameters, etc. In today's dynamic business environment, the ability to systematically track progress toward strategic objectives is a key factor for sustainable growth and effective decision-making. The research analyzes existing methodologies for strategic planning, performance management, and monitoring systems, with particular emphasis on the Balanced Scorecard approach and key performance indicators (KPIs). Based on the identified requirements, a conceptual model of the monitoring system has been developed, including data collection, processing, visualization, and analysis modules. The system architecture is designed to ensure flexibility, scalability, and integration with existing corporate information systems. Special attention is paid to data security, user accessibility, and ethical aspects of information processing. The developed system allows management to receive timely, objective, and comprehensive information about the state of goal achievement, quickly identify deviations, and make informed managerial decisions. The results of the study can be applied in various industries to improve the efficiency of strategic management processes.

Keywords: *balanced scorecard (BSC), complex dynamic system (CDS), controlling.*

1. Introduction

The main task of the information system for controlling the SSP processes of achieving strategic goals is to monitor the progress of planned activities, detect deviations in planned and actual indicators, and carry out procedures to eliminate the identified deviations.

The information system for monitoring the process of achieving strategic goals performs the following main functions:

- detection, identification and management of incidents arising in production and management processes to achieve strategic goals;
- detection of deviations in the values of key process indicators from the planned values, identification of sources of deviations;
- selection of procedures designed to eliminate detected incidents;
- assessment of the impact of the detected violations on the process of achieving strategic goals,
- tracking the dynamics of changes in the indicators of strategic goals for all processes and throughout the company's management hierarchy in accordance with the strategic map of the BSC;
- forecasting the risk of incidents and preventing instability in the process of achieving strategic goals;
- registration of incidents, procedures performed, reporting, etc.

Figure 1 shows an example of the process of changing the values of the strategic objective indicator.

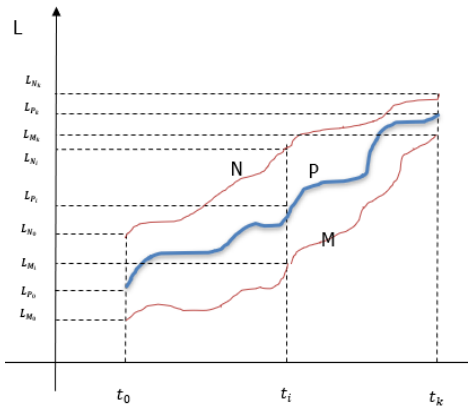

Figure 1. Example of the process of changing the values of the strategic goal indicator [1]

Figure 1 shows:

N is the graph of changes in the upper limit of the permissible deviation of the current value of the controlled indicator (L_{ni}) from the beginning to the end of the process (t_0-t_k).

M is the graph of the change in the lower limit of the permissible deviation of the current value of the controlled indicator (L_{mi}) from the beginning to the end of the process (t_0-t_k).

P is a graph of changes in the current value of the controlled indicator (L_{pi}) from the beginning to the end of the process (t0-tk).

It is normally considered if from the beginning to the end of the process of achieving the strategic goal for this indicator its value is in the range $L_{мі} \leq L_{pi} \leq L_{ni.}$

1.1. Subsection

Another important task of the BSC controlling information system is to identify the type of deviation, connect the appropriate procedures for its prompt elimination, predict the danger of new deviations and take measures to prevent their occurrence. All these procedures are aimed at ensuring the stability of the process of achieving the company's strategic goals.

In practice, the automation of procedures for detecting deviations and determining cause-and-effect relationships between various indicators of the BSC processes is associated with many factors, among which are:

- difficulties in clearly documenting, logging and classifying possible deviations in the controlled processes;
- complexity and duration of the processes of approval for research and analysis of the causes of deviations;
- lack of developed technological tools for planning and implementing changes to eliminate the detected deviations;
- lack of formalized methods for assessing the degree of impact of deviations on the further process of achieving strategic goals;
- the duration and complexity of the preparation of the production dossier.

Management of processes for achieving strategic goals refers to the tasks of managing complex dynamic systems (VCS) with random behavior. Such problems are solved by methods of modeling behavioral analysis. At present, active research is being carried out on the modeling of processes and phenomena in the class of VTS under consideration in order to analyze the cause-and-effect relationships between the components and links of systems [1,2,3,4,5]. However, despite active work and research, practical results in the field are still insufficient [6,7].

2. Materials and methods

In practice, the problem of VTS monitoring is carried out on the basis of a formalized description of cause-and-effect relationships between processes in VTS, determination of characteristic parameters and process indicators, automation of control of changes in these parameters and detection of deviations of actual process indicators from the planned ones.

Summarizing the above, the following steps for monitoring deviations of the real process from the planned one can be noted:

- classification of possible deviations by various parameters (by sources of communication, types of non-compliance, by the degree of influence on other components of the system, etc.);
- dynamic determination of the control method and characteristic parameters;
- automation of the process of comparing actual and planned indicators;
- dynamic assessment of probabilistic values of the relationship between various groups of deviations;
- determining the causes of detected deviations;
- activation of corrective procedures to eliminate deviations;
- collection of statistics and forecasting the emergence of new deviations.

Sources of information on deviations and violations of the stability of processes can be:

- observation of personnel;
- audit reports;
- software system for monitoring indicators, etc.

In all cases, it is important to carefully record the detected situations and describe the problems in detail.

To control the key parameters of deviation identification, there are many methods for calculating, evaluating and visualizing data [8,9,10]. The challenge is to dynamically determine the required inspection method depending on the current production step, the source of the messages and the type of information being analysed, which can be quantitative, textual or binary.

The next important task of the BSC controlling information system is to detect the cause and determine the source of the instability of processes. Depending on the type of deviations and the source of the messages, in some cases the solution of the problem can be a long and complex process. For example, if a deviation in the actual and planned sales volumes of products is detected. To determine the source of the deviation, it is necessary to analyze the cause-and-effect relationships between the indicator of the volume of sales of products and other indicators. If the deviation in the volume of sales is due to a decrease in market demand, then a new analysis of the cause-and-effect relationship between the indicator of market demand and other indicators is carried out. The process continues until the original source of the cause of the deviation is reached. The number of iterations in the analysis of the cause of the deviation may be different depending on the complexity of the cause-and-effect relationships between the indicators.

3. Results and discussion

The main task of the controlling information system in terms of finding the probable cause of the disruption of the stability of the processes of achieving strategic goals is:

- investigation of all possible causes, instability of processes and compilation of a list of deviations in indicators;
- accumulation and consolidation of "historical" data on past similar deviations, values of the main indicators and identified causes;
- structuring and cleaning data for further classification of deviations;
- construction of a stochastic probability's matrix of interdependence of various groups of deviations;
- selection of the most probable cause of instability based on data formalization and expert assessments.

Studies carried out at the stages of identification of instability and determination of probable causes, supplemented by an analysis of the relationships between individual processes of the system, will make it possible to establish the cause of the observed deviations.

4. Conclusions

Cause-and-effect diagrams based on the measured values of characteristic parameters and their relationship can be

used to carry out appropriate studies based on visual representation. The solution to the problem of identifying deviations and detecting probable causes is possible through the machine implementation of self-organizing systems, which would allow, on the basis of the classification of deviations and the accumulated "historical" data, to determine the sample of the required method of analysis and the corresponding characteristic parameters of data control and visualization. In addition, the machine method based on these historical data will make it possible to calculate dynamically changing probabilistic values of the relationship between the deviations of different groups. This will make it possible to determine with high reliability the main cause of the detected deviations.

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Стратегиялық мақсаттарға қол жеткізу процесі мониторингінің ақпараттық жүйесін әзірлеу

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Аңдатпа. Ауытқуларды анықтау процесін автоматтандыру және негізгі көрсеткіштерді бақылау стратегиялық мақсаттарға қол жеткізу процесінің тұрақтылығын қамтамасыз ету бойынша түзету және алдын алу іс-қимылдарын жоспарлау мен жүргізудегі маңызды қадам болып табылады. Анықталған ауытқуларды талдау күрделі динамикалық жүйенің (SDS) қарастырылып отырған класындағы өзара байланысты кездейсоқ оқиғалар мен процестерді зерттеуге бағытталған көп сатылы процедура болып табылады. Ауытқуларды сәйкестендірудің дұрыстығы оларды анықтау әдістеріне, бақылау әдістеріне, параметрлерді формальды түрде ұсынуға және т. б. байланысты. Бүгінгі күнгі динамикалық бизнес ортада стратегиялық мақсаттарға жету барысын жүйелі түрде қадағалауға мүмкіндік беретін қабілет тұрақты өсу мен тиімді шешім қабылдауда негізгі фактор болып табылады. Зерттеу стратегиялық жоспарлау, өнімділікті басқару және мониторинг жүйелері бойынша қолданыстағы әдістемелерді талдайды, ерекше назарды Balanced Scorecard тәсілі мен негізгі өнімділік көрсеткіштеріне (KPI) аударады. Анықталған талаптарға негізделе отырып, мониторинг жүйесінің концептуалды моделі әзірленді, оған деректерді жинау, өңдеу, визуалдау және талдау модульдері кіреді. Жүйе архитектурасы икемділікті, масштабталуды және қолданыстағы корпоративтік ақпараттық жүйелермен біріктіруді қамтамасыз ету үшін құрылды. Деректердің қауіпсіздігіне, пайдаланушылардың қол жеткізуіне және ақпаратты өңдеудің этикалық аспектілеріне ерекше назар аударылады.

Негізгі сөздер: *теңдестірілген көрсеткіштер жүйесі (ТКЖ), күрделі динамикалық жүйе (СДЖ), бақылау.*

Разработка информационной системы мониторинга процесса достижения стратегических целей

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Аннотация. Автоматизация процесса определения отклонений и контроль основных показателей является важным шагом в планировании и проведении корректирующих и превентивных действий по обеспечению стабильности процесса достижения стратегических целей. Анализ обнаруженных отклонений представляет собой многошаговую процедуру, направленную на изучение взаимосвязанных случайных событий и процессов в рассматриваемом классе сложной динамической системы (СДС). Достоверность идентификации отклонений зависит от способов их обнаружения, методов наблюдения, формализованного представления параметров и т.д. В современных динамичных бизнес-условиях способность систематически отслеживать прогресс к стратегическим целям является ключевым фактором устойчивого роста и эффективного принятия решений. В исследовании анализируются существующие методологии стратегического планирования, управления эффективностью и системы мониторинга, с особым акцентом на подход Balanced Scorecard и ключевые показатели эффективности (KPI). На основе определенных требований была разработана концептуальная модель мониторинговой системы, включающая модули сбора, обработки, визуализации и анализа данных. Архитектура системы спроектирована для обеспечения гибкости, масштабируемости и интеграции с существующими корпоративными информационными системами. Особое внимание уделяется безопасности данных, доступности для пользователя и этическим аспектам обработки информации.

Ключевые слова: *система сбалансированных показателей (ССП), сложная динамическая система (СДС), контроллинг.*

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