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CYBERNETIZATION OF MANAGEMENT PROCESSES IN INNOVATION ACTIVITIES

КІБЕРНЕТИЗАЦІЯ ПРОЦЕСІВ УПРАВЛІННЯ В ІННОВАЦІЙНІЙ ДІЯЛЬНОСТІ

ANNOTATION

The article substantiates the methodical approach to cybernetization of management processes at enterprises in terms of innovation activity, which is usually characterized by high level of uncertainty of expected results of enterprises economic activity. The proposed methodological approach, different from the known ones, consists in restructuring the management of enterprises in the conditions of their innovation activity, based on the use of a modern applications complex. They provide solutions to the main tasks of the cybernetics components. This reduces the risk of ineffective transfer of managerial information and reduces the impact of objective and subjective problems affecting managerial decision-making. The method of management cybernetization is suitable for both large and small enterprises.

Keywords: management process, cybernetics, management optimization, management information, stages of managerial process.

АНОТАЦІЯ

У статті обґрунтовано методичний підхід до кібернетизації процесів управління на підприємствах за умов інноваційної діяльності, яка зазвичай характеризується високим рівнем невизначеності очікуваних результатів економічної діяльності підприємств. Запропонований методичний підхід, на відміну від відомих, полягає у перебудові управління підприємствами за умов їх інноваційної діяльності на основі використання комплексу сучасних прикладних програм. Саме вони забезпечують вирішення основних завдань компонентів кібернетики. Це дає змогу знизити ризик неефективної передачі управлінської інформації та зменшити вплив об'єктивних та суб'єктивних проблем впливу на прийняття управлінських рішень. Метод кібернетизації управління підходить як для великих, так і для малих підприємств.

Ключові слова: процес управління, кібернетика, оптимізація управління, управлінська інформація, етапи управлінського процесу.

АННОТАЦИЯ

В статье обоснован методический подход к кибернетизации процессов управления на предприятиях в условиях инновационной деятельности, которая обычно характеризуется высоким уровнем неопределенности ожидаемых результатов экономической деятельности предприятий. Предложенный методический подход, в отличие от известных, заключается в перестройке управления предприятиями в условиях их инновационной деятельности на основе использования комплекса современных прикладных программ. Именно они обеспечивают решение основных задач компонентов кибернетики. Это позволяет снизить риск неэффективной передачи управленческой информации и уменьшит влияние объективных и субъективных проблем влияния на принятие управленческих решений. Метод кибернетизации управления подходит как для больших, так и для малых предприятий.

Ключевые слова: процесс управления, кибернетика, оптимизация управления, управленческая информация, этапы управленческого процесса.

Formulation of the problem. The scientific and technical process, which is rapidly developing, becomes the main mechanism of the economic process regulation. Changes that occur in the external and internal environment of the enterprise are characterized by the need to find new management methods and solutions. All this in a new way raises the question of managing the company as a subject of market relations, its ability to adapt to the dynamic conditions of the market. Possible decision to adapt to the existing market can be considered cybernetization of management, because it is such a science as cybernetics is engaged in the process of efficient transmission, storage and information processing, during the transfer of managerial decision.

Analysis of recent research and publications. The following scientists studied the cybernetics and its significance in the management process are N. Wiener, I.N. Drohbitsky, A.I. Berg, Y.I. Chernyak, V.M. Glushkov, V.F. Turchin, T.A. Vashko, N.V. Markov, Y.I. Fet, A.A. Shiyan etc.

The purpose of the article is to substantiate the need for cybernetization of the management process to avoid distortion of information during its transmission.

Presentation of the main materials of research. Management is a process of developing, adopting and implementing targeted effects on any element of a managed system or on the system as a whole, designed to ensure its effectiveness and efficiency at the current moment in an accessible for the prospect.

Process Management is a set of specific activities aimed at streamlining and coordinating the operation and development of the organization and its elements in order to achieve their goals [7, p. 25].

This process is characterized by continuity, cyclic repeatability of individual phases (collection, processing, analysis, storage, control of information and decision making, organization of their implementation), unevenness, inertia, which manifests itself in the lateness of managerial actions. It develops and improves with the organization itself.

Each controlled system should have the freedom to choose the trajectory of the movement to a given goal – a strategic plan. It reflects the intermediate system state, the methods of transferring the system from one state to another and necessary resources for this [10, p. 66]. In order to make the best choice of trajectory to the goal, the managed system should be able to compare alternative trajectories. This means that there are must be criteria for comparison and ways to determine (compute) their values [8; 9].

A managed system should have the resources to ensure the implementation of the managerial decisions generation. First of all, it relates to human resources. In the controlled elements (subsystems) of the system there are must be people (specialists) who adequately perceive generated management decisions and can translate them into life [5, p. 92]. The moment of the transition of management decision from the governing body to direct executives is a “bottleneck” for most economic systems. Lack of information on the problem can lead to unreasonable management decisions. Without information there is no management [7, p. 59].

The development of alternative options and the adoption of management decisions are informational and knowledgeable nature and occur in a wielding intellect environment. Such developments necessarily provide for possible consequences. For such a prediction, a model is required [20, p. 118–222]. Such cybernetization of the organizational management will go through the formalization and development of all three acts of managerial influence. Managerial decisions will not only be the result of creativity, but will be designed and calculated as engineering solutions. Any management solution generated by them can be subjected to quantitative verification (recalculation) due to the cybernetic model of management (fig. 1).

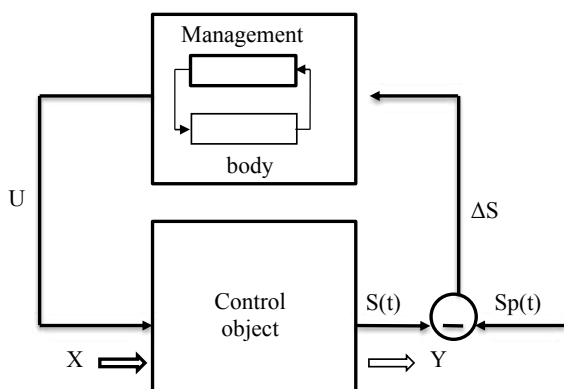


Fig. 1. The cybernetic management model

Legend:

X – input stream (raw materials, materials, energy, etc.);

Y – outflow (products, services);

$Sp(t)$ – planned state of the managed system;

$S(t)$ – current state of the managed system;

ΔS – divergence between planned and current states;

U – managerial influence

In response to the current “challenge” of the information exchange management, transmission and storage, such a science as cybernetics develops. Cybernetics is a science of information management. The subject of studying cybernetics is the management processes in complex dynamic systems. Cybernetics examines only those aspects of the systems functioning, which determines the flow of control processes in them, that is, the processes of collecting, processing, storing information and its use for management purposes [19, p. 214–230].

The main theoretical tasks of cybernetics are [1, p. 106–110]:

1) establishing facts common to managed systems or for some of their aggregates;

2) finding common laws that are followed by controlled systems;

3) detection of restrictions inherent in managed systems;

4) determination of the ways of practical use of established facts and found patterns.

The main practical task of cybernetics is optimization: that is, the solution to the problem of how to achieve the organization of each element of the system under such conditions, such interaction between elements and exchange with the external environment, so that the results of the functioning of these systems were the best, that is, minimize costs (time, raw materials, energy, human labor, etc.) that are used to achieve a given goal [17, p. 55].

Cybernetics has established that in all systems, the control processes are implemented according to a single scheme, which involves the collection, processing and transmission of information. Accordingly, any cybernetic (self-regulating) system with a closed control circuit (information transformation) represents a set of control subsystem (subject, control body), controlled by a subsystem (object control) associated with a closed loop of information conversion. In the general case, the following stages and nodal points can be distinguished in the study of information flows (fig. 2).

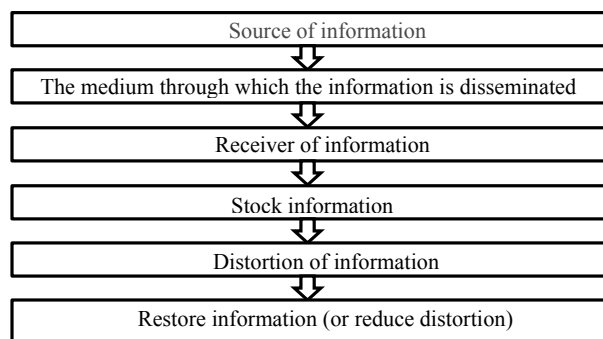


Fig. 2. Cybernetic model of traffic information flow

Thus, it can be noted that in the course of the information flow, there is inevitable distortion of information. In today’s environment, the proper use of information can be a decisive factor in busi-

ness success. Information and coordination based on it in all areas of activity of individual units of organizations helps to bind them together, to make rational and adequate management decisions and to ensure the organization's activities in a changing external environment through communications [18, p. 54].

As a result of information perceptions expanding as a strategic resource, information begins to be practically mastered as a means of influencing the activities of staff within the organization and its interaction with the staff of other firms and consumers, that is to be a means of influencing the improvement of the enterprise activity quality and behavior change in the market in a favorable firms of the direction [11, p. 214].

Management information is a piece of data that has the novelty and usefulness for a specialist to make a well-founded decision. The main task of the information management environment is to bring the necessary information to the particular employee at the right time [13, p. 23]. Requirements for information in management, and, accordingly, possible negative consequences in case of its non-compliance with the specified requirements are given in table 1.

The demand for integrated and reliable management information is closely linked to the growth of the IT sector. Each company seeks to create its own operational management system and involves qualified professionals [2].

The table shows the cause-and-effect characteristics of the distortion of information regarding

non-compliance with requirements. Information in one way or another in the process of movement in the information flow is distorted. In the work of T.A. Vashko distinguish the following causes of distortion of data [1, p. 219]:

1) the imperfection of the information processing system structure (including the disadvantages of the data processing technological process, and the disadvantages of the model of the management object);

2) incomplete algorithms, errors in programs that handle requests for the delivery of certain messages;

3) failure of the equipment operation;

4) human-operator errors.

The author notes that the main source of errors is the operator-operator. At the stage of collecting, preparing and writing messages made from 61% to 98% of all errors.

It follows that if at the initial stage information was obtained in a distorted form, further successful management process and implementation of rational management decisions is impossible. Such distortions may be caused by a number of reasons for which scientists are advised to resort to cybernetization to neutralize them.

In modern conditions, the development of the scientific and technological revolution has led to the life of automation, production cybernetization, expanding the scale of the transformation of spiders into the direct productive power of society, radically changed the means of labor, in general, leads to an improvement in the welfare

Table 1

Requirements for management information

| Requirements for management information | Possible consequences in case of non-compliance of the information with the specified requirement |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timeliness, efficiency | Late information complicates the timely decision-making, increases the degree of risk, and brings considerable losses. |
| Reliability (basic reliability parameters: authenticity, objectivity, completeness) | Most of the false decisions of the governing body, the head, and civil servants are due to insufficient level of reliability of the information they receive. |
| Optimality (characteristic of measures in the ratio of necessary and sufficient information) | 1) Excess information overloads communication channels, leads to an increase in the intensity of interference (physical and semantic noise), complicates decision-making; 2) the lack of necessary information increases uncertainty, degree of risk and the danger of false decisions, that leads to increased costs. |
| Accessibility and ease of perception (parameters: conciseness, expressiveness, visibility) | In the absence or lack of appropriate properties, the manager spends extra time, applying for clarifications to assistants and experts. |
| Logic and conciseness (maximal semantic load with the minimum size of the information carrier, the compressibility of the time interval of the message transmission) | In the absence or inadequate data quality increases the time spent on the processing and assimilation of information, the content of the message in the memory of the subject of control (manager, specialist) is complicated. |
| Complexity, systematic | In the absence of these qualities, the effectiveness of the decisions is reduced, especially when the object of control becomes more complicated and the degree of uncertainty of the environment increases. |
| Correspondence of the information authority and the competence of the subject of management | Failure to comply with this requirement raises the problem of redundancy or insufficiency of information with corresponding negative consequences, plus additional time losses of the manager, managers, specialists of different levels of the hierarchy of management for coordination, clarification, etc. |

of society, man, his health, which is not only the personal value of a person, but also social.

Management of social systems and processes has a set of very significant “cybernetic” features, which makes it possible and legitimate, as well as, as practice shows, the fruitful use of ideas, models and constructions, tools and methods of cybernetics in social management. Such use of the results obtained by cybernetics in the first approximation and can be defined as cybernetization control [4].

As any process of cybernetization management has its advantages and disadvantages are given in table 2.

However, even with the drawbacks, scientists point out the inevitability of cybernetization in the current technological progress. Now there are immeasurably more technological opportunities for creating and using such systems for managing economic, social and other processes. But realistically such systems today are possible only within the framework of separate enterprises or corporations. Capitalist social relations do not promote the introduction of automated systems [6].

Under conditions of competition and commercial secrecy it is impossible to collect and process information in real time and the interests of private owners and corporations are extremely rarely the same as the interests of society as a whole. Also, the question arises about the reliable protection of the data of the enterprise, personal data of their employees, etc. With the introduction of cybernetization, the protection of information is one of the most important factors of success [3].

The manager should be able to see the information received, to monitor the measures taken, the effector and the afferent channels through which these measures were carried out. At the present stage, cybernetization is carried out at the expense of the components of cybernetics with the use of applications that allow solving existing tasks (Fig. 3).

Based on this structure, we can say that cybernetics is a complex science, whose components set different tasks and solve them with the help of a unique package of applications. Most of these programs are free and are in the public domain. However, large enterprises finance the develop-

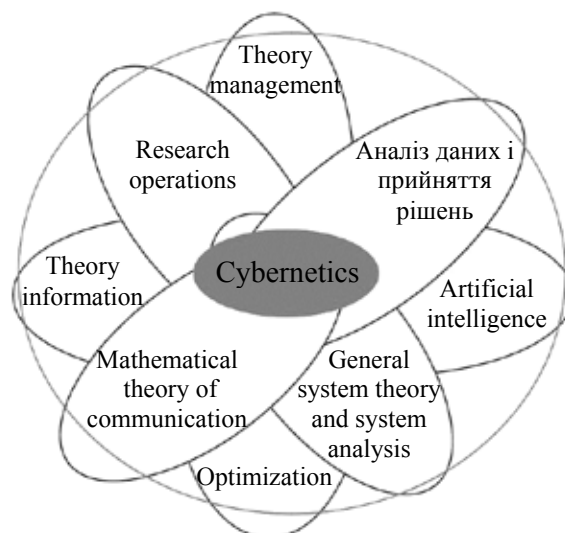


Fig. 3. Structure and structure of cybernetics

ment of their own software. On the other hand, for small enterprises, such costs are irrational, so the optimal solution for them can be such programs table 3.

The table presents the main programs that implement the tasks of the cybernetics components, but they are much larger. There are also many economic calculators on the Internet that allow conducting factor and financial analysis, calculating the parameters of microeconomics and macroeconomics, etc.

However, even in spite of the variety of programs that simplify the process of processing information, in domestic enterprises, in most cases, obsolete methods are used. This may be due to a number of reasons: each enterprise uses its system of indicators, and sets itself different targets for calculations; additional training is required to use such programs; lack of knowledge of managers in the existence of the above-mentioned means of making managerial decisions.

Conclusions. The solution is the main product of the manager’s work. The success of the case depends on the effectiveness of managerial decisions. Therefore, every management decision must be scientifically substantiated and timely

Table 2

Disadvantages and advantages of cybernetization

| Advantages of cybernetization | Disadvantages of cybernetization |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Replacement of human labor in tasks that include physical labor and monotonous work. | 1. The need to select staff of the appropriate narrow qualification or to spend resources for advanced training or re-engineering of employees of the enterprise. |
| 2. Replacement of human labor in a hazardous environment (as fire, space, volcanoes, nuclear facilities, under water, etc.). | 2. Each company needs an individual approach in the course of cybernetization. |
| 3. Performing tasks that are beyond human capabilities in parameters of size, weight, speed, endurance, etc. | 3. High material costs for the creation of such systems. |
| 4. Significantly reduces the time of operations and processing. | 4. Reducing jobs |
| 5. Gives the worker the opportunity to engage in other activities related to intellectual work. | |

Table 3

Examples of applications that provide solutions to the main tasks of the components of cybernetics

| A component of cybernetics | Main tasks | Software |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Operations research (OR) | OR is used in solving tasks of production planning (controlling, logistics, marketing) and other complex tasks. Application to the economy in the economy can increase the productivity of the enterprise [12, p. 126]. | Mathcad, MathLab, Excel |
| Decision support systems in business | An interactive computer system designed to help the decision maker use links, data, documents, knowledge and models to identify and solve problems and formulate solutions. As such an object on the basis of the analysis, already formed practice can be called: financial analysis and forecasting; sales marketing and procurement; analysis of stereotypes of client behavior and detection of hidden patterns [8, p. 207]. | ERP, GIS, DocFlow, Business Modeller, SCADA/DCE, Project Management and other |
| Optimization of business processes | Provides rethinking and transforming the business of the organization to better coordinate the activities of its functional units and enhance their flexibility. Optimization is aimed at achieving higher performance and lower costs [16, p. 183–188]. | 1C |
| System analysis | System analysis is aimed at researching and designing large (large-scale) and complex systems, managing them under conditions of incompleteness of information, resource constraints and a lack of time [14, p. 220]. | Attack Surface Analyzer |
| Theory of information | The section of applied mathematics, radio engineering and informatics, relating to the measurement of the amount of information, its properties and sets the boundary relations for data transmission systems. Operates mathematical models, uses the mathematical apparatus of probability theory and mathematical statistics. The main sections of the theory of information – source coding and channel coding [11, p. 277]. | Pascal, C# and other programming languages |
| Mathematical theory of communication | Comprehensive, basically mathematical theory, which includes description and evaluation of methods for extracting, transmitting, storing and classifying information. It consists of coding theory, algorithms and many others. It is part of the theory of information and solves the same tasks [15, p. 291]. | Pascal, C# and other programming languages |
| Artificial Intelligence | The section of computer linguistics and informatics, dealing with the formalization of problems and tasks that resemble tasks performed by a person. Artificial intelligence is precisely the task of using computers to understand human intelligence, but not necessarily limited to biologically plausible methods. | Not used in the economy |

adopted, be in line with the situation and legislative acts, meet the objective conditions of the development of trade enterprises, and provide the most complete achievement of the set goal and rational use of resources.

Analysis of managerial information showed that the information in one way or another in the process of movement in the information flow is distorted. Such distortions may be caused by a number of reasons, including: imperfect structure of the information processing system; algorithms imperfections, errors in programs that process requests for the issuance of certain messages; equipment operation unreliability; human-operator errors. Among the human-operator errors are the most significant ones.

Due to the use of the cybernetization method, the main task of cybernetics is realized – optimization of the managerial process, and allows to react to problems in real time, and to support the acceptance of managerial decisions.

The scientific novelty of the results obtained is to improve the methodological approach to cybernetization of management processes at enterprises under the conditions of innovation activity, which is usually characterized by a high level of uncertainty of the expected results of economic activity

of enterprises; which differs from the known is to reorganize the management of enterprises in the conditions of their innovation activities, based on the use of a complex of modern applications that provide solutions to the main tasks of the components of cybernetics; and it reduces the risk of inefficient transfer of managerial information and reduces the impact of objective and subjective problems affecting management decisions.

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