

METHODOLOGICAL REGULATIONS ON THE CLASSIFICATION OF MANAGEMENT INFORMATION SYSTEMS

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In this article the interpretation of the terms “automatic informational system” and “managerial informational system” are specified, developed and implemented the methodical elaborations for principles of managerial informational system classification, the correspondence of the category of management information systems to the levels of management in the general model of enterprise management is highlighted, the classification of existing managerial informational system of domestic enterprises was formed.

Key words: automated information system; management information system; classification of management information systems; digital factories; smart factories; virtual factories.

Problem statement

In the conditions of the transformation of the economy, the formation of a market-oriented economic system, denationalization and privatization of economic property, intensifying competition in the market, the level of responsibility of domestic business entities for the rational formation and use of all types of resources, including material, financial, labor, information, etc., in order to ensure the effectiveness of the enterprises. Implementation of this task requires modern organizations to form market-adequate management systems that would flexibly respond to the dynamics of the operating environment factors and could ensure optimal use of available and engaged resources in order to form an acceptable level of performance by adopting an appropriate management decision. In the enterprise management system, management information systems are designed to contribute to the development of mechanisms for the optimal ratio and structure of income and expenses in order to establish strict financial discipline at the enterprise, minimize losses, ensure the targeted distribution of limited resources, etc. In addition, they should facilitate management decision-making.

Relevance of research

At domestic enterprises, management information systems are used at a rather low or primitive level, since there is no practical awareness of the role of such systems, available software, necessary qualifications of employees, sufficient information about the process of creating information systems at the enterprise. Every year, the number of management information systems of various directions and their developers is growing on the Ukrainian market. Based on their advertising and reference materials, it can be stated that almost all systems are positioned as fully functional integrated management systems that provide automation of all the main management processes of any enterprise [1]. Unfortunately, this does not reflect the real situation. How to satisfy the enterprise with adequate information provision of its activities? All this makes it necessary to first of all form the theoretical and methodological principles of the classification of

management information systems as a basis for the applied use of this technology in the management system of domestic enterprises in order to improve the effectiveness of their activities.

Formulation of hypothesis and goal setting

In the context of the identified issues and based on the results of the analysis of the latest research, the following goals are set in the article:

- clarify the interpretation of the term “management information system”;
- to develop and propose methodological provisions regarding the principles of classification of management information systems;
- form a classification of existing management information systems of domestic enterprises.

Analysis of recent research and publications

The problems of creating management information systems in enterprises at the current stage are extremely relevant, this is confirmed by their comprehensive review in literary sources on the subject of information systems and information management, enterprise finance, management, enterprise economics, etc. At the same time, the problems of creating or choosing management information systems are the object of interest not only among scientists, but also among entrepreneurs, managers, economists and accountants. As noted by М. Черненко [2, p. 33–39] and С. Слепцов [3, p. 15–21] the applied value of management information systems enables them to develop intensively, which results in a great diversity of such systems, their types, and classes. At the moment, management concepts have already formed on the market, which function effectively, and the information systems used do not always correspond to these concepts [4]. The named authors, as well as В. Гужва [5, p. 25–26], В. Пономаренко, Р. Бутова, І. Журавльова, а Г. Назаров, Л. Павленко, О. Пушкар [6] investigate the fundamental concepts forming the category “management information system”: information, information system, automated organization management information system. However, they do not provide an interpretation of the management information system.

Classifications of management information systems are incompletely developed. Among them, only the classification proposed by І. Карпачов [7] is used in the practice of the developers of such systems. In it, the systems are assigned to four classes: local, financial and management, medium integrated and large integrated. Depending on the generalized type of enterprise, of which there are four according to І. Карпачов – small, trading and distribution, medium-sized manufacturing enterprises and multifunctional holdings, some matrix of system application is proposed. Such a classification is not without its shortcomings and is to a large extent too generalized both with respect to the classification of systems and with respect to the classification of enterprises. After all, it is not necessary for the holding to use a large integrated system. At the holding level, the management of capital profitability is necessary, and to solve the problems of operational management of a separate structural division, systems that are best suited for this type of tasks and direction can be used. Therefore, the management of information flows at the enterprise requires further clarification of the essence of the term “management information system” and the development of a new and improved classification of such systems.

Main part

If we study the problems of classification of management information systems, it would be advisable to pay attention to the essence and interpretation of the terms “information”, “system”, “information system”, “automated information system of organization management” and determine their relationship to the term “management information system”. In separate literary sources [8, 9] it is indicated that information is information about any events, someone’s activities, etc.; message about something; information in any form and form, on any medium (including correspondence, books, notes, illustrations (maps, diagrams, drawings, schemes, etc.), photographs, holograms, motion pictures, video films, microfilms, sound recordings, databases of computer systems or full or partial reproduction of their elements), explanations of persons and any other publicly announced or documented information. System – an order caused by the correct, planned

arrangement and mutual connection of parts of something; a well-thought-out plan; established, accepted order [8, 9]. Information system according to В. Пономаренко [6, p. 29] is a system that organizes memory and manipulation of information regarding the problem area. And the Great explanatory dictionary of the Ukrainian language [8, p. 405; 9] at the same time, the concept of an information system is presented as such – it is a system designed to solve tasks of search and logical processing of information. The automated information system of organization management is an interconnected set of data, equipment, software, personnel, standards of procedures designed to collect, process, distribute, store, and provide information in accordance with the requirements arising from the organization's activities [5, p. 25].

It would be appropriate to propose a term that would connect the automated information system of organization management with the process of organization management. Such a term can be a management information system, which is an interconnected set of data, equipment, software, personnel, standards of procedures designed for the collection, processing, distribution, storage, provision of information for making an appropriate management decision.

Generalization of the above state of the problem requires the development of a new approach to the classification of information systems. It should be based on a number of requirements, the main ones of which should be as follows:

- the classification should provide a clear definition and criteria by which management information systems can be attributed to a specific class of systems;
- the relationship between the economic tasks of the enterprise and the functional completeness of the systems must be clearly monitored;
- the classification of information systems should be based on the classification of economic tasks of the enterprise, for the solution of which these systems are used;
- the classification should help enterprises in making the choice of systems, which will make it possible to reduce its cost.

To form the principles of classification, we suggest using standard concepts that are used to classify any objects and phenomena: category, class, species, type.

The software, as mentioned above, should be based on the economic tasks of the enterprise. Here it will be appropriate to present the organization's management hierarchy. Each level of management is characterized by its time limits for planning and execution of tasks and the degree of generalization of information for planning and control. Five levels of management can be distinguished: strategic, medium-term, operational, operative and real-time management [4, 10].

Time limits for strategic planning are three to five years. This plan sets the main goals of the enterprise that it wants to achieve during this period. The basis here is long-term forecasts in various spheres of activity. The degree of detail of such a plan is not high, but the decisions made at the strategic level have a significant impact on the long-term performance indicators of the enterprise. Decisions made at this level have the nature of mandatory conditions or production restrictions, taking into account which the enterprise must work in any time perspective.

The level of medium-term management covers time limits of a year and a half. The medium-term plan is actually a detail of the strategic plan for the near term.

Operational management is carried out within the framework of one month to a year. At this level, specific options for the most profitable use of resources are developed, taking into account the limitations determined by the decisions of higher levels of management.

Operational management is the current daily or weekly management, which deals primarily with the order of tasks, solving current problems.

Real-time management is management in the mode of solving urgent tasks and problems. This level of management may be absent in many enterprises, but it is mandatory in the management of technological processes of a continuous production cycle or in the management of complex logistics systems. Norms and regulations can act as a plan at this level.

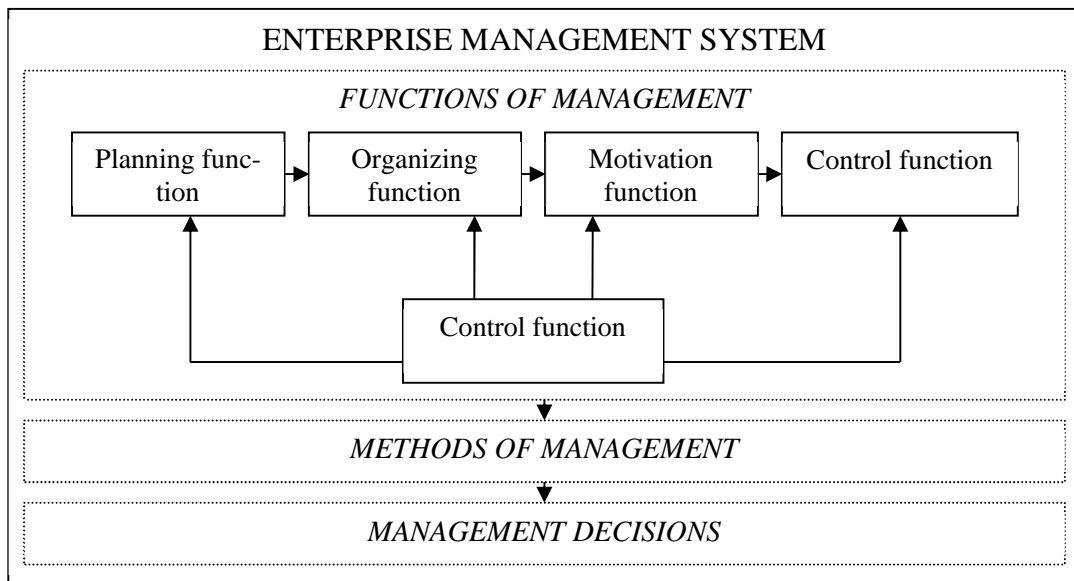
Correspondence of categories of management information systems to levels of management in the generalized model of enterprise management

Management levels	System category
Strategic management level (3–5 years)	The category of strategic management support systems
Medium-term management level (1–1.5 years)	The category of business efficiency management systems
Operational management level (1–12 months)	The category of operational management systems
Operative management level (day-week)	
Real-time management level	The category of automated management systems

In accordance with the levels of management of the enterprise, it is possible to distinguish the classification of management information systems according to the following categories (Table):

- strategic management systems;
- medium-term management systems;
- operational management systems;
- operative management systems;
- management systems in real time.

To build classes of systems, one should take into account the management functions that are performed in the process of managing the enterprise (Fig.) [11]. The process of performing management functions is a cyclical process.



General functions of management in the enterprise management system [11]

Automated systems should make it possible to implement general management functions through specific ones. In particular, such types of work should be implemented as information analysis, planning and replanning of events in connection with changing circumstances, accounting, control of the implementation of plans, as well as the development of recommendations by the system for making a management decision. The allocation of classes of automated systems should occur through different levels of management. The complete implementation of management functions will be one of the main criteria for the classification of management information systems, since all functions are present at each level of management. However, at some enterprises, some functions are performed formally or not fully.

It is advisable to divide systems of the same class into types on the basis of types of economic activity, types of production, types of products, which are decisive for the application of certain methods of

operational management. For example, small batch production management, flow management, project management, MRP management, etc.

Division of systems into types can be carried out on the basis of types of software, which forms the basis of such a management information system. Of course, for each category and class there will be separate types of systems that should be formed separately. As an example, the following types can be distinguished: systems-forms, systems-constructors and their combination.

Formation of the classification of the existing management information systems of domestic enterprises will be carried out on the basis of assigning one or another system to the appropriate categories, classes, kinds and types. At the level of system categories, we highlight:

- strategic management systems – provide support for management functions at the strategic level, as well as mostly analysis, planning and control; examples of such systems are CORPORATE PLANNER, Project Expert, MS Project, Balanced Scorecard, Microsoft Dynamics, etc.;

- medium-term management systems – these are business performance management systems (Business Performance Management, or Corporate Performance Management); they include both specialized systems of budget planning, control and regulation of deviations (Hyperion Pillar, Adaytum, Comshare MPC, Oracle Financial Analyzer, SyteLine Budgeting), as well as class 1C tools (Инталев-бюджетирование, Парус);

- operational management systems – designed to provide operational and operational management; these include foreign developments SAP R/3, Oracle Applications, BAAN, SyteLine ERP, MFG PRO, IRenaissance, IFS, “Галактика”, “Парус:Х”, as well as Ukrainian developments (“ІТ-Підприємство”, BS Intergator, “Програмные системы развития”, product group 1C).

- real-time management systems are very specialized and depend on specific conditions of production at a specific enterprise, so they cannot be presented in this article.

According to the depth of coverage of management functions, operational management systems can be classified into the following four classes of systems:

- accounting systems;
- management accounting systems;
- enterprise resource planning and management systems (ERP systems);
- highly specialized systems, for example, MES-production executive systems or EAM-systems for managing the company’s fixed assets.

Today, attempts are being made to divide the factories of the future into three main types – digital, smart and virtual [12, 13]. The tasks of “digital factories”, “smart factories” and “virtual factories” can be implemented by means of integrated intelligent information management system of smart innovative enterprises [14].

The main task of the “digital factory” – the development of models produced using digital design and modelling [15, 16]. The tasks of the “digital factory” here can be performed by intelligent research information system (IRIS); intelligent design automation system (ICAD), the components of which may be an intelligent automation system of functional design (ICAD-F); intelligent system of automation of design engineering (ICAD-E) and intelligent system of automation of technological design (ICAD-T) based on the following systems and technologies [14, 17]:

- systems CAD/CAM/CAE as computer-aided design systems (CAD), where CAE (Computer Aided Engineering – computer systems of engineering analysis) – CAD-F computer systems for automation of engineering calculations, analysis and functional design; CAD (Computer Aided Design – design with the help of a computer) – CAD-K system of geometric modelling, drawing and design works; CAM (Computer Aided Manufacturing) – CAD-T technological preparation of production;

- PDM (Product Data Management) – product data management system;

- PLM (Product Lifecycle Management) – application software for product lifecycle management.

The integrated intelligent information management system are able to perform the tasks of “smart factories”, which can use the following basic systems and technologies [3]:

- IISTPP – intelligent information system of technological preparation of production;
- MRP-2 (Manufacturing Requirement Planning) – manufacturing planning and material requirements;
- APS (Advanced Planning and Scheduling) – synchronous (advanced) manufacturing planning;
- MES (Manufacturing Execution Systems) – manufacturing executive system designed to solve operational tasks of design, production and marketing management;
- SCADA (Supervisory Control and Data Acquisition) – a system that performs dispatching functions (collection and processing of data on the state of equipment and technological processes) and helps to develop software for embedded equipment;
- CNC (Computer Numerical Control) – system of direct software control of technological equipment on the basis of controllers (specialized (industrial) computers) built into technological equipment with numerical software control;
- IIoT (Industrial Internet of Things);
- Big Data.

The tasks of the “virtual factory” can be implemented based on the following systems and technologies [14]:

- AEMS – automated enterprise management systems;
- ERP (Enterprise Resource Planning) – supports all business processes of the enterprise: planning, financial management, sales, production, logistics, operations, relationships with customers and suppliers, reporting, etc., developed on the basis of ERP (Enterprise Resource Planning) – enterprise planning and management and includes SCM (Supply Chain Management) and CRM (Customer Relationship Management).

The intermediate position between automated enterprise management systems and automated process control systems is occupied by the production executive system MES (Manufacturing Execution Systems), designed to solve operational problems of design, production and marketing management. Data management in the integrated information space during all stages of the product life cycle is entrusted to the product lifecycle management system PLM (Product Lifecycle Management). A characteristic feature of PLM is the interoperability of different automated systems of many enterprises, i.e. PLM technologies (including CPC technologies, collaborative product commerce) is the basis that integrates the information space in which CAD, ERP, PDM, SCM, CRM and other automated enterprise systems operate.

Conclusions and prospects for further research

The implementation and functioning of management information systems at enterprises at the current stage is an extremely urgent problem, which primarily requires theoretical and methodological justification. The article clarifies the interpretation of the term “management information system”, developed and proposed methodical provisions regarding the principles of classification of management information systems, presented the classification of existing management information systems on the domestic market, which will facilitate the choice of a system adequate for the company’s activities.

The scientific results of the article include:

- the interpretation of the term “management information system” was clarified for the purpose of developing methodological provisions regarding the principles of classification of management information systems;
- developed and proposed methodical regulations regarding the principles of classification of management information systems;
- the classification of existing management information systems on the domestic market is presented.

At the same time, there is a need to more thoroughly cover issues related to the methodology of building a management information system.

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МЕТОДИЧНІ ПОЛОЖЕННЯ ЩОДО КЛАСИФІКАЦІЇ УПРАВЛІНСЬКИХ ІНФОРМАЦІЙНИХ СИСТЕМ

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У статті уточнено трактування термінів “автоматизована інформаційна система” та “управлінська інформаційна система”, розроблено і запропоновано методичні положення щодо принципів класифікації управлінських інформаційних систем, визначено відповідність категорій управлінських інформаційних систем рівням управління в узагальненій моделі управління підприємством, сформовано класифікацію управлінських інформаційних систем вітчизняних підприємств.

У системі управління підприємством саме управлінські інформаційні системи покликані сприяти розробленню механізмів оптимального співвідношення та структури надходжень і витрат з метою формування на підприємстві жорсткої фінансової дисципліни, мінімізації втрат, забезпечення цільового розподілу обмежених ресурсів тощо. З кожним роком на українському ринку зростає кількість управлінських інформаційних систем різного спрямування та їх розробників. На підставі їхніх рекламних і довідкових матеріалів можна констатувати, що майже всі системи позиціонуються як повнофункціональні комплексні управлінські системи, які забезпечують автоматизацію усіх основних управлінських процесів будь-якого підприємства.

За результатами дослідження запропоновано виділяти такі класи і категорії інформаційних систем: відповідно до рівнів управління підприємства (системи стратегічного управління, системи середньострокового управління, системи операційного управління, системи оперативного управління, системи управління в режимі реального часу); за глибиною охоплення функцій управління системи операційного управління можна зарахувати до таких чотирьох класів систем (системи бухгалтерського обліку, системи управлінського обліку, системи планування і управління ресурсами підприємств (ERP-системи), вузькоспеціалізовані системи, наприклад, MES – виробничі виконавчі системи чи EAM – системи управління основними фондами підприємства).

Ключові слова: автоматизована інформаційна система; управлінська інформаційна система; класифікація управлінських інформаційних систем; цифрові фабрики; розумні фабрики; віртуальні фабрики.