

ANALYSIS OF APPLICATION OF INFORMATION SYSTEMS AT INDUSTRIAL ENTERPRISES

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Abstract: This article is devoted to the research of the management system at industrial enterprises, as well as application of ICT thereto. Based on the research results, the author has developed relevant proposals and recommendations.

Key words: management system, information system, managerial decision-making.

Introduction: In modern management one of the most vital issues challenged by the management of a company of a voluntary character is the rational use of information systems in the development of management decisions. The level of rapid development of the economy requires from information systems to provide final users with the accurate and reliable information in a timely manner.

According to our analysis, only those companies that have the leaders who are competent at decision-making with the use of additional opportunities offered only by modern information systems are achieving positive results, and not just inside the country, but also throughout the world, ensuring their competitiveness in the world market.

Fundamentals of development of information systems, methodological aspects of design and development of information systems for branches and industries of the national economy, methodological approaches to comprehensive information management of enterprises and companies, mechanisms of efficient implementation of various management information systems

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have been revealed in scientific papers of different scientists-economists, both foreign and domestic. The majority of them have devoted their scientific papers to the research of the theoretical and methodological aspects of information systems management and econometric analysis, design and development of information systems and technologies for the objects of the national economy, as well as the use of ICTs and IT systems in settling various problems of the national economy. In this regard, N.B.Abdusalomova in her research has highlighted the role and importance of information technologies in the management accounting system.

Nevertheless, the management of industrial enterprises has not adequately examined the broader use of information systems and their efficient functioning. The shortage of integrity in the development of the principle of this issue does not provide an efficient mechanism for the use of information management systems in business management. Therefore, the development of complex approaches to the widespread use of corporate information systems implies the need to effectively utilize them in the management system of various types of ownership which helps to determine the objectives of this research.

Modern management should pay a particular attention to systemic approach to the business activities. An enterprise is considered to be a socio-technical system related to human activities and is regarded as an integral system that closely cooperates with the external environment in which the energy, information and other resources necessary for its operation are obtained.

The main characteristics of the enterprise system are the system objectives, system boundaries, and the external environment. The system's initial characteristic is its ability to resist the environment. The external environment is a complex of the objects which are not incorporated in the system. The environment, being apart from the system analyzed, is considered to be a part of the real life that represents a particular interest for us. Therefore, the system is a limited set of objects that have been isolated from the environment through the system boundaries.

There are many mutual interrelations between the environment and the business-structure represented by the enterprise. These interrelations serve as mediation between the environment and the system.

Analysis and results. When considering enterprise activities from the point of view of general governance, this enterprise is a sustainable formal social structure that accepts resources from the environment and turns it into a product of its own.

The table below illustrates the analysis of the production volume of ABC enterprise within the period of 2014-2018 (Table 1).

Table 1

Production volume of ABC enterprise within the period of 2014-2018 (by types of products)¹

Product name	Years					Growth rate in relation to 2017, in %
	2014	2015	2016	2017	2018	
Natural gas condensate (thousand tons)	355,92	377,31	362,18	369,67	380,158	102,8
Certain operations involving the preparation of natural gas by the subcontractor (million UZS)	1 096,905	1 293, 131	1 233,969	1 299,480	1 536,518	118,2
Other working clothes (thousand UZS)	1 487,0	1 636,0	97 998,0	156 480,47	167 331,0	107
Liquefied propane and butane (thousand tons)	236,06	256,65	262,18	257,45	271,537	105,5
Technical sulfur (except for sublimated, refined and colloidal sulfur) (tons)	267 550,7	254 629,0	236 870,3	290 375,2	249 187,2	85,8
Other heating and hot water (heat energy) (thousand Gkal)	1 961,9	2 018,47	2 051,39	1 927,3	1 292,203	67

¹ Developed by the author on the basis of the reporting of the enterprise.

According to the data presented in Table 1, in 2014 natural gas condensate amounted to 355,92 thousand tons, and by 2018 it reached 380,158 thousand tons. During the same period, certain operations involving the preparation of natural gas by the subcontractor amounted to 1 096,905 million UZS in 2014, and by 2018 this indicator grew to 1299,480 million UZS. As for other working clothes, this indicator constituted 1487,0 thousand UZS in 2014, and in 2018 this indicator totaled 156480,47 thousand UZS. In 2014 liquefied propane and butane accounted for 236,06 thousand tons and by 2018 this indicator grew to 271,537 thousand tons. From the data in the table it is obvious that in 2014 technical sulfur amounted to 267550,7 tones and in 2018 the trend was downward making 249187,2 tones. Other heating and hot water constituted 1961,9 thousand Gkal in 2014, but in 2018 this indicator reduced to 1292,203 thousand Gkal.

Efficient introduction of modern ICTs will facilitate the growth of production, cost reduction, and urgent supervision over information flows, i.e. efficient management of information flows between the production shop, department and overall management. This, definitely, is related to the effective implementation of corporate information systems into the management of the enterprise.

In this regard we have also analyzed financial results of the enterprise, export volumes, the residual of finished products at the end of the period, average number of employees, average nominal wage and profitability of the enterprise (Table 2).

Table 2

Overall indicators of ABC enterprise within the period of 2014-2018²

	Years				
	2014	2015	2016	2017	2018
Financial results (profit, loss) (million UZS)	-	102582,6	3816,3	5525,8	8855,7
Volume of export (thousand USD)	6119,8	6868,0	7558,9	24824,4	9469,0

² Developed by the author on the basis of the reporting of the enterprise.

Residual of the finished products at the end of the period (<i>million UZS</i>)	10546,6	7465,6	13325,8	32948,0	57441,0
Average number of employees in the list (<i>number of people</i>)	3998	4301	4447	4256	3584
Average salary (<i>thousand UZS</i>)	1 475,6	1 521,5	1 589,2	1 820,2	2 558,2
Profitability (%)	-	8,6	0,3	0,4	0,5

As it is shown in Table 2, in 2018 financial results amounted to 8855,7 million UZS, exports constituted 6119,8 thousand USD in 2014 and in 2018 this figure increased considerably totaling 9469,0 thousand USD. As for residual of the finished products at the end of the period, in 2014 this indicator amounted to 10546,6 million UZS, however by 2018 this indicator rose significantly and constituted 57441,0 million UZS. The number of employees accounted for 3998 people in 2014, however in 2018 this indicator was equal to 3584 (with a tendency of personnel growth and reduction), the average nominal salary constituted 1 475 thousand UZS in 2014 but by 2018 this figure increased and equaled 2 558,2 thousand UZS. The profitability of the enterprise accounted for 0,3% in 2015 and in 2018 it increased up to 0,5%.

Taking into account all the above mentioned indicators, it is necessary to analyze socio-economic indicators for efficient organization of business, to economize financial, labor and material resources using ICT, and to monitor and influence internal and external processes. This, in turn, requires automation through the introduction of corporate information systems in management activities of the industrial enterprises.

When conducting our research we have analyzed the average production capacity of the enterprise for product types per year. According to this analysis, natural gas condensate constitutes 494400 tonnes, liquefied propane and butane constitute 306600 tonnes, technical sulfur - 463869 tonnes and heating and hot water - 3000000 Gkal.

The age structure of machinery and equipment used in the basic production (in terms of the equipment production year) amounts to 93,5% for 3 years, 3,3% for 4-5 years, 1,9% for 6-10 years, and 1,3% for over 10 years. Herewith, the amortization value of the equipment and machinery used in the basic production accounts for 31,9% (in terms of the equipment production year) ³.

Efficient implementation of an automated system of management is particularly important for effective management of production activities, modern ICTs and technological process management in manufacturing of existing production equipment, materials and human resources. While modern ICTs provide rapid supervision over the information flows, an automated process control system enables the enterprise to collect information on technological processes and manage the technological processes carried out by the enterprise's responsible persons. This ensures maximum efficiency and safety of technological processes.

In this regard there is also a service for the introduction and development of ICT at the enterprise. Its main objectives are servicing and control of servers, computers, printers and software, making banners and plotters, installation and maintenance of video surveillance cameras, antivirus software installation and maintenance of local, internet and VPN networks.

The technical department of the enterprise is responsible for working out plans on the implementation and development of modern ICTs, software and hardware, information processing and storage, communication, data transfer and information security, automation of business processes, including creation of information systems and resources, as well as introduction of interactive services. Moreover, it carries out comprehensive programs on developing the state information policy at the enterprise, electronic document management system, raising the level of computer technology, introduction and development of the ICT, automation of data collection, processing and storage.

³ Reporting of the enterprise

In general, the management of the enterprise undertakes all necessary measures to ensure security of the information transfer through local networks, internet, VPN networks in each production workshop. In addition, special facilities in the form of tourniquet tracking have been installed to control the entry of employees into their workplaces.

Nevertheless, automation of business management, development of economic, technical and social spheres have caused the need to accelerate information flows.

The analysis has illustrated that changes in the external environment of the enterprise have a dynamic nature, and there is a significant uncertainty in the reaction to the environment. Management of the enterprise is the organization of business activities with the account of changes in the economic and social environment, distribution of financial, labor and material resources to achieve the objectives set forth.

The objective of the management is to monitor and respond to internal and external processes so that the change in economic conditions can promote the company's development.

As a result of the research, with the aim of creating a single information environment of the enterprise we have introduced integrated information systems and methods of their application (Figure 1).

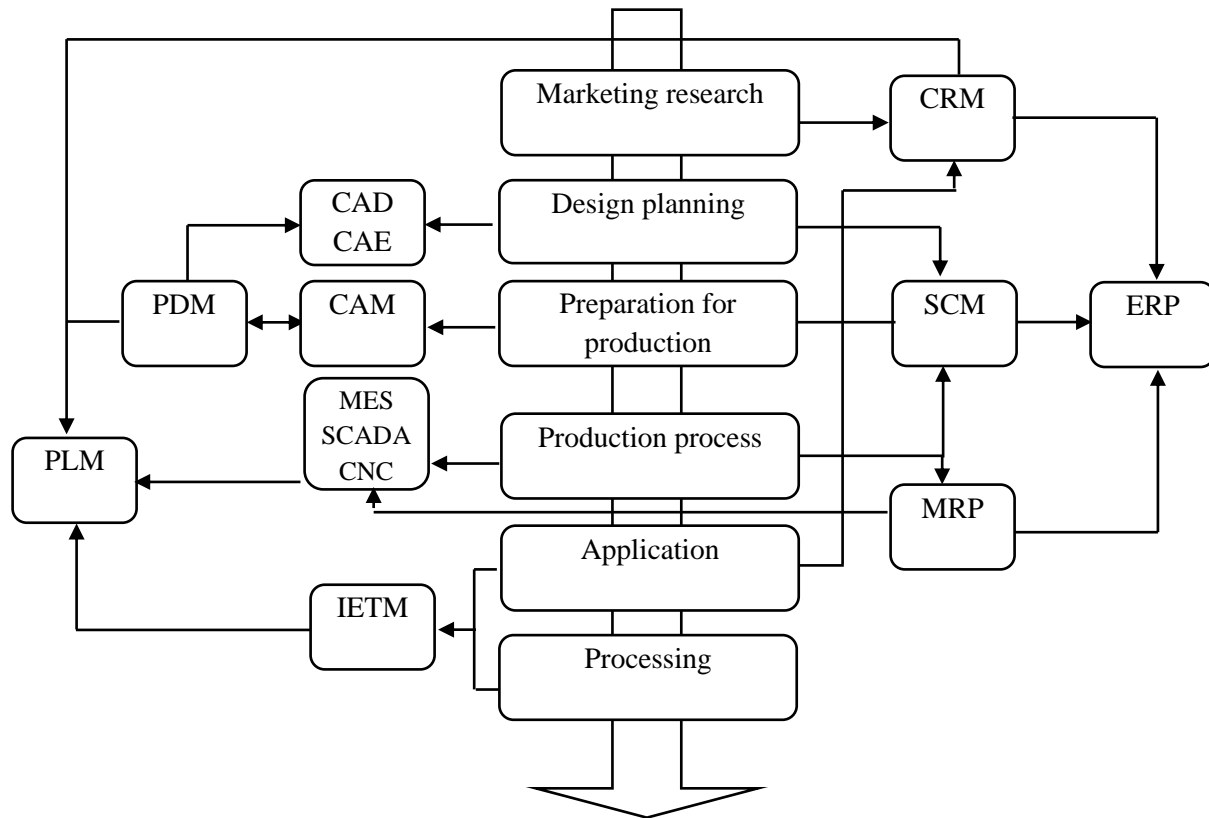


Figure 1. Life-cycle and applied information systems of the products manufactured by the enterprise⁴

Figure 1 shows that corporate communication systems are interconnected in each life-cycle. For example, CRM (Customer Requirement Management) is the management system intended to communicate with customers for marketing research. The SCM (Supply Chain Management) is a supply chain management system, CAD (Computer Aided Design) and CAE (Computer Aided Engineering) automated designing systems are used during the design planning stage. In this process, the CAD and the CAE interact with the product data management system PDM.

Integration of basic and additional processes in these information systems, integration of specific functional modules of information systems are carried out on the basis of organization of information exchange system EAI (Enterprise Application Integration). Informational integration involves the integrated use of one-time input to eliminate uncontrolled information flows and performing operations on the information processing. This sets forth the single requirements for the forms and methods of storage, transfer and delivery of information, and identifies a unified

⁴ Developed by the author on the basis of the research

standard for information processes. This is important for economic and other information to be added to the voluntary information systems. In modern information systems of the enterprise management systems of electronic documentation exchange and CALS⁵ technologies, as well as the system of managing technological data at the industrial enterprises are implemented on the basis of PDM.

As a result, efficient management of the data and information flows will be provided and will serve as a major source for decision making in the field of automation of the enterprise.

The industrial enterprise is a complicated organizational and technical system which operates different control and automated systems. Depending on the scope of automation of the enterprise, it will directly support production, design and technological activity of the enterprise in the creation and manufacturing of new types of products, as well as information and analytical support of economic and management services. According to our analysis, different classes of information systems and technologies are used to solve different management tasks.

The functions of an integrated information system play an important role in the management of ABC enterprise. Enterprise management consists of various management systems. The following basic types are applied in the production systems:

- execution, regulation (automated management);
- technical and economic management (management of production and equipment);
- economic management (management of organizational structures);
- strategic management.

As a result of our research we have introduced the following model for modern automation projects (Figure 2).

⁵ CALS technology is a complex of industrial products. The key features are design, technology, production, marketing, and operational documentation.

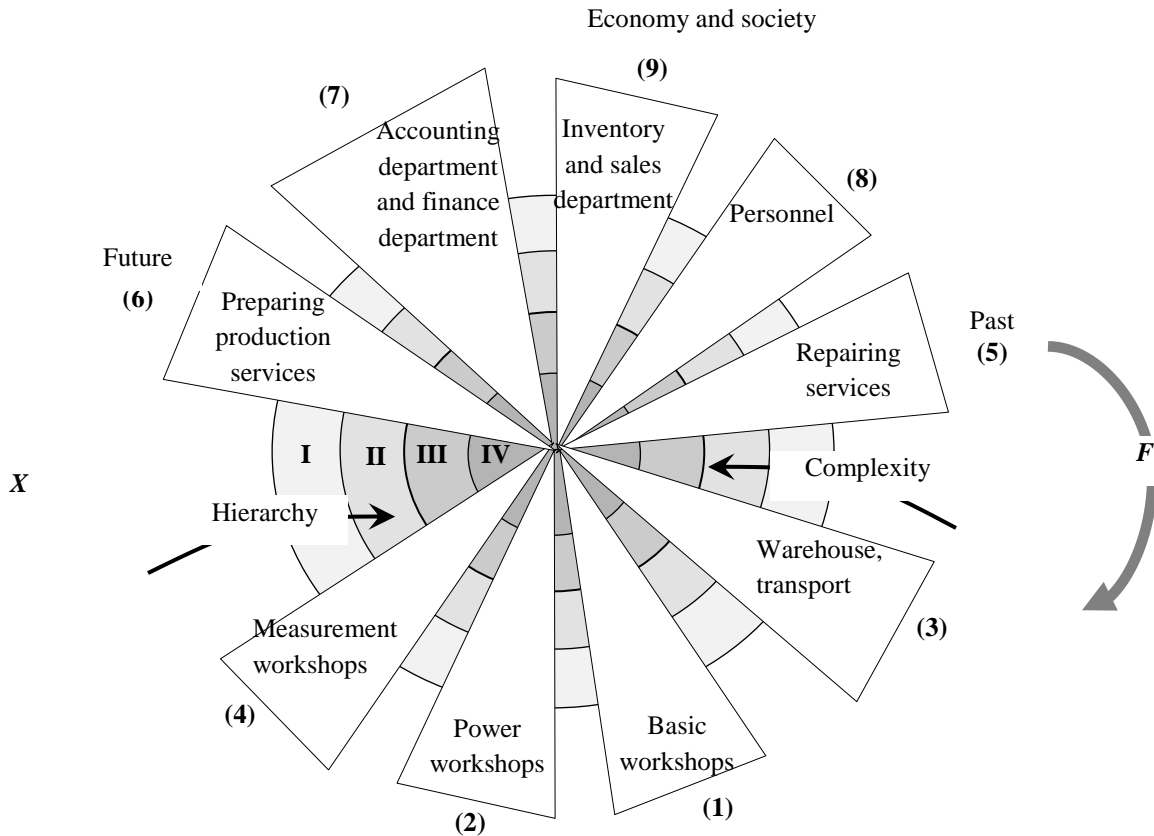


Figure 2. Management system of the industrial enterprise presented as an organizational hierarchy⁶

As Figure 2 illustrates, this chart is conditionally divided into external and internal units. The objects and systems of enterprise management are depicted inside. This includes hierarchical pyramids of enterprise functions. Outside we can see material production and various foreign markets.

Now we compare the functionality and level of the automation system with the management structure of ABC enterprise. Herewith the organizational structure of the enterprise constitutes its basis. The pyramid is based on the performance of the executors working directly with the facilities, and at the angles of the pyramid we can see overall management of the enterprise.

The above-stated model also describes four hierarchical stages of organization (i.e. organizational hierarchy). The first stage is represented by the executors (operators) who are

⁶ Developed by the author on the basis of the research

responsible for execution and regulation. The second stage is represented by separate production sites and management services that are responsible for technical management.

The third stage is shown as a separate production workshop and departmental management system (managers), responsible for technical and economic management, and the fourth stage is the director, his or her deputies and their staff (management) and responsible for strategic management.

In addition, the model depicts the typical structure of the enterprise's core functions, namely internal and external functions, basic and auxiliary. Here X – is a hierarchy of vertical production relations, F – the function of the enterprise. The model also includes pyramids that fit the functions of the enterprise and its organizational units.

They are: (1) – basic production workshops, (2) – power production workshops, (3) – warehouses and transport services, (4) – measurement workshops, (5) – repairing services, (6) – preparing production services, (7) – management of the enterprise' resources, (8) – personnel management, (9) – inventory and sales department. Elements (7), (8), (9) of the model usually constitute the management of the enterprise.

Figure 3 depicts the intrinsic circles that describe the major types of control and the main classes of automation systems that comply with those of the enterprise's hierarchy:

- automated management systems and technological process management systems;
- production management systems, computerized integrated production;
- integrated information management systems of organizing production of ERP type;
- systems of managing efficiency of enterprises' performance.

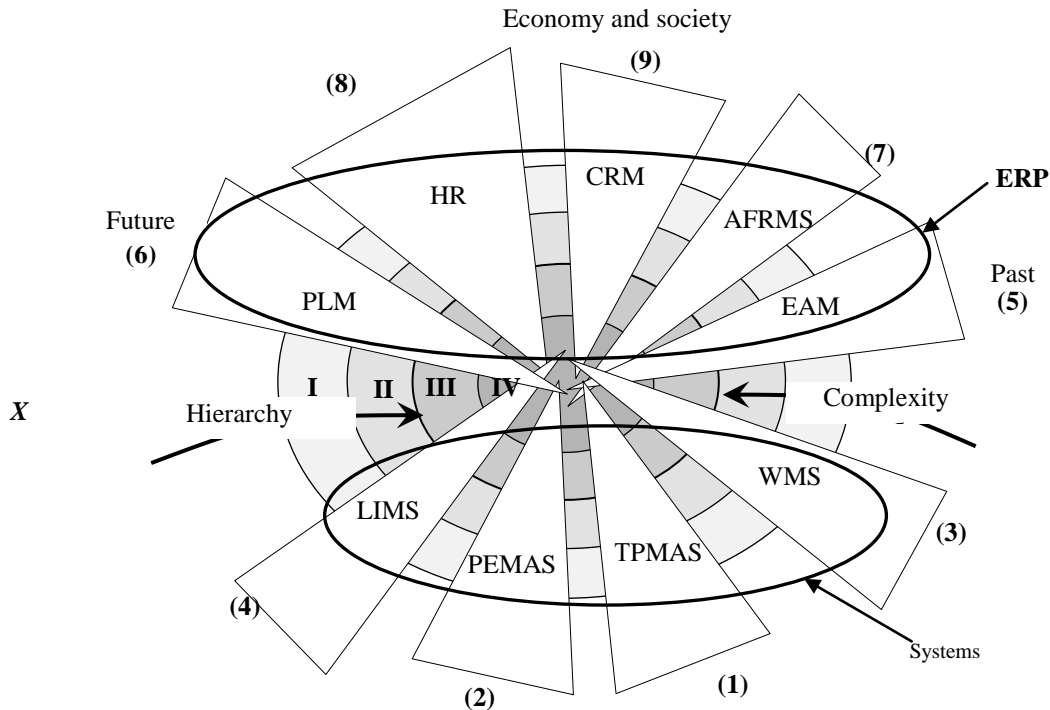


Figure 3. Basic types of the automated production systems⁷

CRM (Customer Requirement Management — customer relationship management systems);

HR (Human Resources — personnel management systems);

EAM (Enterprise Asset Management — fixed assets management systems);

WMS (Warehouse Management System — warehouse management system);

AFRMS— accounting and financial reporting management system;

TPMAS – technologic process management automated system;

PEMAS– power entities management automated systems.

According to our analysis under modern conditions, integration of these classes will be ensured at all levels of organizational hierarchy. The first two classes of automation are directly related to production equipment and production processes.

The lower system or automation layer is generated by information management systems of the automated process management systems or DCS - Distributed Control Systems according to the automation standards of the enterprise. Sometimes this system is subdivided into two systems: controller and dispatcher (or a lower system of the SCADA system).

⁷ Developed by the author on the basis of the research

In modern automated information systems they are typically implemented with the help of SCADA (Supervisory Control and Data Acquisition - dispatcher management and data acquisition, DCS, PLC (Programmable Logic Controller) - programmable logic controls). SCADA systems are an integral part of the automated information management system. Implementation of SCADA systems in enterprise management will result in a significant reduction in the use of secondary equipment at a large enterprise by bringing the indicator and dispatching of technological information to the dispatcher's room and will make a positive economical effect.

Figure 3 illustrates that the LIMS (Laboratory Information Management Systems) is integrated with laboratory systems, fixed asset management systems, and SCADA systems, and, in case of necessity, with MES information systems.

As it can be seen in Figure 3 above, there are systems for operational management of production processes that rationally distribute production equipment, materials and human resources available in production, in contrast to large-scale enterprise resource management systems. MES production management systems provide dispatching and control of the technical and economic indicators of production systems. The main tasks of MES information systems include rapid production scheduling, quality control, and timing of product delivery in real time, as well as optimization of production graphics.

At ABC enterprise an integral solution for the automation of this production is represented by Computer Integrated Manufacturing – CIM. The CIM concepts and solutions are related the integration of production and management systems which occurred at the beginning of 1980s.

In the next layer or stage of economic automation, they allocate MRP or ERP systems for the enterprise management. MRP / ERP is an enterprise management system that guides all the resources of the enterprise, providing support of the basic and supplementary processes of the enterprise, and promotes planning and control processes in the basic functional areas of the enterprise. The ERP administrative system is an automated management of financial, economic

and administrative activities of the enterprise. Enterprise resources represent financial, labor, material, raw materials, and finished products.

Complex design and manufacturing of modern and sophisticated products, including design and technological aspects, as well as feasibility studies, will be the virtual modeling of future production and will be implemented in the modern systems of automation using product life cycle management systems (PLM). The performance of this system is based on the life-cycle of the products.

At high hierarchical levels (hierarchies III and IV), instrumentation and analytical tools are used to support tactical and strategic management of the enterprise.

It should be noted that specialized ICT and other technologies are used for strategic decision-making with the account of peculiarities of decisions made by the management of industrial enterprises.

In Figure 3 axis X demonstrates vertical hierarchy interrelation. As the circle approaches the center, the number of contacts decreases and the pyramid narrows. However, the horizontal functional relationships are just as intense as the information they share. The intensity color of the grey circle, which corresponds to the pyramidal level of control, depends on the fact how vigorous is the situation. The center will be based on the strategic management functions that are incompatible with intellectual activity and decision-making, solutions to less structured problems, and complete automation of all processes. Intelligent ICTs and decision-support systems for information processing are not automated from the principal aspect, but managed by human beings. These systems do not deal with the data processing and accounting systems that cover only the key areas of activity, including industry-related information. Here you will find information about changes occurring in an external environment, statistical information about the past, as well as predictive developments that reflect the future development and trends of the entity. These levels of organizational hierarchy support the use of enterprise content management systems and technologies (ESMs), corporate knowledge management systems and technologies,

as well as strategic analytical techniques, cognitive and model technologies, and facilitate strategic decision-making.

Conclusion. At present, ICTs (including sensors to intellectual systems) and ICT prototypes, based on relevant automation standards in the markets, serve as a reliable tool for the creation of automation systems for all levels of management hierarchy.

In conclusion it should be noted that it is possible to save the time of specialists at the enterprise as a result of modern information and communication technologies. The only way to make significant economic profit from time-saving is to direct the amount of the time economized on the specific issues of the subdivision of the enterprise based on the overall strategy of the enterprise. That is as they say, who possesses the information, those own the entire world. In this regard currently it is very important for such key performance indicators, such as speed, reliability, accuracy, high speed of data transfer and processing, which in many respects determine the efficiency of any decision-making in business management.

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