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ANALYSIS OF TENDENCIES IN MECHANICAL ENGINEERING ENTERPRISES INFORMATION SYSTEMS DEVELOPMENT

Abstracts - The aim of this article is to research and systematize peculiarities, find out tendencies and define the problems of mechanical engineering enterprises, substantiate the efficient management system playing a vital role not only in providing management efficiency but also in enterprise development processes. Therefore, the purpose of the study is to identify trends and problem areas of implementation of information systems management in engineering enterprises
Key words: management system, information systems, management decisions

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АНАЛІЗ ТЕНДЕНЦІЙ РОЗВИТКУ МАШИНОБУДІВНИХ ПІДПРИЄМСТВ З ВИКОРИСТАННЯМ ІНФОРМАЦІЙНИХ СИСТЕМ

У статті досліджуються та систематизуються особливості, тенденції та визначаються проблеми функціонування підприємств машинобудування, обґрунтовується ефективна система управління, яка відіграє важливу роль не тільки в забезпеченні ефективності управління, а й у процесах розвитку підприємства. Таким чином, мета дослідження полягає у виявленні тенденцій і проблемних областей реалізації управління інформаційними системами машинобудівних підприємств.
Ключові слова: система управління, інформаційні системи, управлінські рішення

Socio-economic conditions and limitations in financial resources are involving on the engineering enterprises development and business in Ukraine. The crisis complicates this situation, the consequences of which are fully reflected in the engineering enterprises sector. In addition, the modern economy is characterized by growing instability of the external environment, especially the unpredictability of demand, increased competition, the changing of the state's role in the economy. Obviously, machine-building enterprises should build a strategy of development in such conditions, relying on its own resources mainly, solving the problems of sustainability by reducing costs, improving management efficiency. To increase the efficiency and reliability of management information and the timely decisions are primary objectives in these conditions. The introduction of modern information systems is the way to solving these tasks.

The complicated process of domestic industry development is substantially influenced by preceding historical events as well as modern market tendencies. Lengthy industrial production recession in Ukraine began to show when the country received its independence status and has been caused by many factors both external and internal. External factors comprise the following: national economy structural reconstruction which takes a long period of time; inflation and inflationary expectations leading to higher interest rates on short-term credits; investment activity decline etc. [9].

There are several most important internal factors influencing the operating efficiency of industrial enterprises. Firstly, it is the enterprise's technological level (manufacturing equipment condition and structure, quality of equipment service and maintenance, level of transport-storehouse supply, technological processes progressive character according to production stages). Secondly, it is the industrial engineering status (workshops and sections specialization levels, smooth production flow, manufacturing resources functioning capacity, methods of manufacturing planning etc.). Finally, it is the business operation status (strategic planning level, optimal production, marketing and forecasting programme formation, accounting and analysis quality, managerial decisions technology, personnel motivation) [7].

Mechanical engineering as a complex branch is a fundamental industry providing related branches with necessary equipment, stimulating their economic growth, and creating additional workplaces. The products of mechanical engineering enterprises play the vital role in scientific and technological progress realization for all the national economy sectors.

The specialization tendencies and patterns of different Ukrainian mechanical engineering enterprises are shown in table 1. Enterprises of heavy engineering metal consuming branches are distributed in Donets Basin, Prydniprov'ya and Kharkiv. The main centres are Kramators'k, Horlivka, Dnipropetrovs'k, Donets'k, Kryviy Rih, Luhans'k, Debaltseve, Mariupol', Druzhkivka etc.

The main transport engineering centres are Luhans'k, Kharkiv, Dnipropetrovs'k, Dniprodzerzhyns'k, Stakhanov, Kremenchuk, Mariupol', Mykolaiv, Kherson, Kyiv, Kerch, Zaporizhzhya, Luts'k, Lviv.

Electrotechnical engineering is being developed in Kharkiv, Zaporizhzhya, Khmelnytskyi, Poltava, Kamyanets'-Podil'skyi, Odesa, Donets'k, and Berdyans'k. The main centres of workbench production are Kharkiv, Kyiv, Zhytomyr, Odesa, Dnipropetrovs'k, Kramators'k, Berdychiv, and Cherkasy. Kyiv, Kharkiv, L'viv, Sumy, Dnipropetrovs'k, Odesa and other big cities are the centres of instrument engineering producing electronics, measuring and other instruments. Tractor-building and agricultural engineering is developed in Kharkiv, Kirovohrad, Odesa, Dnipropetrovs'k, and Ternopil'. Enterprises in Kyiv, Sumy, Poltava, Dnipropetrovs'k, Odesa, L'viv, Fastiv, and Drohobych produce chemical industry equipment, and those in Kyiv, Kharkiv, Dnipropetrovs'k,

Odesa, Poltava, Cherkasy, Smila, L'viv, and Simpheropol manufacture food industry equipment. Light industry is being provided with equipment by engineering enterprises of Kharkiv, Kyiv, Poltava, Chernivtsi, Kherson, Melitopol, Odesa, Ivano-Frankivs'k, Berdychiv etc.

Table 1

Mechanical engineering specialization by regions in Ukraine [18]

Regions	Mechanical engineering specialization
Donets Basin	Heavy and transport engineering
Western region	Chemical, electrochemical and agricultural engineering
Podillya region	Equipment and instrument production, electrotechnical and agricultural engineering
Prydniprov'ya region	Electrochemical, agricultural, automotive and heavy engineering
Prychornomor'ya region	Shipbuilding, road-building and hoist transport system engineering; workbench, equipment and instrument production
Kharkiv region	Power machine building, electrotechnical, agricultural and transport engineering
Central region	Workbench, equipment and instrument production; chemical, electrical and radio engineering.

Defense industry complex is a part of mechanical engineering branch developing and producing intelligent and science intensive produce. Nowadays defense industry is concentrated at 300 enterprises of Ministry of Industrial Policy, State Space Agency and Ministry of Defense. In the period of economic transformation the manufacturing cooperation schemes in defense industry broke down and led to fragmentary pattern of Ukrainian defense potential. This process created specific difficulties while adapting defense industry complex enterprises to the market economy.

To define the tendencies in mechanical engineering branch development over the last few years we need to estimate its activity. Table 2 represents the financial results analysis of engineering enterprises (in the light of engineering produce manner of manufacture and compared with data of the whole industry).

It is obvious that mechanical engineering enterprises were the most successful in 2012, when the before-tax financial results were 47957.3 million UAH. Previously the best results were achieved in 2007, and the before-tax financial results of routine activity made up 5127.5 million UAH. 2009 showed the lowest qualitative indices in mechanical engineering as 45,9% of engineering enterprises sustained losses. In our opinion it was caused by negative influence of world financial and economic depression. The share of profit-making enterprises rose from 66,7 % in 2006 to 67,9 % in 2012. But comparing to 2009 the number of profit-making engineering enterprises in 2012 rose by 11 %.

However the analysis of before-tax routine activity profit structure grouped by mechanical engineering produce show that transport and equipment engineering enterprises suffered the most. In 2012 the world financial depression caused 242845,5 million UAH of material losses at these enterprises.

Table 2

Industrial enterprises financial results (profits and losses) during 2006-2012 [18]

	Pre-tax profit (loss) (millions UAH)	Enterprises which earned a profit		Enterprises which incurred losses	
		% of total number of enterprises	financial results (millions UAH)	% of total number of enterprises	financial results (millions UAH)
1	2	3	4	5	6
2006					
Industry	34699,6	65,3	45903,0	34,7	11203,4
Mechanical engineering including	1916,9	66,7	3895,1	33,3	1978,2
- automotive and equipment production	734,2	64,2	1478,3	35,8	744,1
- electrical, electronic and optical equipment production	587,9	69,8	1124,7	30,2	536,8
- transport and equipment production	594,8	64,6	1292,1	35,4	697,3
2007					
Industry	43700,9	66,6	56956,9	33,4	13256
Mechanical engineering including	5127,5	69,2	7137,4	30,8	2009,9
- automotive and equipment production	1434,2	67,9	2328,2	32,1	894
- electrical, electronic and optical equipment production	1347,9	71,4	1792,9	28,6	445
- transport and equipment production	2345,4	65,4	3016,3	34,6	670,9

Table 1 (continued)

1	2	3	4	5	6
2008					
Industry	20243,2	61,1	70812,5	38,9	50569,3
Mechanical engineering including	704,6	63,9	7412,0	36,1	6707,4
- automotive and equipment production	918,8	62,9	3062,5	37,1	2143,7
- electrical, electronic and optical equipment production	224,5	66,1	1787,9	33,9	1563,4
- transport and equipment production	-438,7	59,1	2561,6	40,9	3000,3
2009					
Industry	-3948,1	54,1	39611,7	45,9	43559,8
Mechanical engineering including	2547,3	56,9	7893,1	43,1	5345,8
- automotive and equipment production	2274,8	53,6	3814,3	46,4	1539,5
- electrical, electronic and optical equipment production	1937,9	62,6	2468,5	37,4	530,6
- transport and equipment production	-1665,4	51,7	1610,3	48,3	3275,7
2010					
Industry	26530,5	58,2	61629,1	41,8	35098,6
Mechanical engineering including	5531,0	63,6	8596,6	36,4	3065,6
- automotive and equipment production	1828,8	61,0	3256,5	39,0	1427,7
- electrical, electronic and optical equipment production	953,6	67,5	1582,8	32,5	629,2
- transport and equipment production	2748,6	61,4	3757,3	38,6	1008,7
2011					
Industry	63260,9	62,1	111105,1	37,9	47844,2
Mechanical engineering including	14396,4	67,2	17976,8	32,8	3580,4
- automotive and equipment production	2207,9	66,9	3686,5	33,1	1478,6
- electrical, electronic and optical equipment production	2088,3	68,4	3263,6	31,6	1175,3
- transport and equipment production	10100,2	62,9	11026,7	37,1	926,5
2012					
Industry	10855379,6	64,1	17290347,7	35,9	6434968,1
Mechanical engineering including	47957,3	67,9	514198,9	32,1	466241,6
- automotive and equipment production	135994,9	66,9	199596,9	33,1	63602,0
- electrical, electronic and optical equipment production	154807,9	69,5	257229,5	30,5	56801,1
- transport and equipment production	–242845,5	67,0	102993,0	33,0	345838,5

The most profit-making enterprises operated in electrical, electronic and optical equipment production, totaling maximum 69,8% in 2006 and 69,5% in 2012.

The main reason for the rise in quantity of unprofitable enterprises in Ukraine was the sharp decrease in sales of their products beginning from 2009 (table 3).

Recently the part of mechanical engineering products sold in general industrial production fluctuating between 10 % and 14 %. So in 2011 it was 12,03%, in 2006 it rose to 12,46%. But in 2012 the situation substantially worsened and mechanical engineering products sales in Ukraine decreased sharply to 216,37 billion UAH. The part of mechanical engineering products sold in general industrial production comprises 3,4%, which is the trough of the last 7 years. Transport and equipment production in 2012 made up the largest part of 1,4%.

The dynamics of profitability indicators in Ukrainian mechanical engineering in 2005-2012 is shown on Fig. 1.

Table 3

Sales of industrial products (services) 2001-2012 [18]

Year	Units	Industry	Mechanical engineering	Automotive and equipment production	Electrical, electronic and optical equipment production	Transport and equipment production
2006	UAH billions	551,73	68,73	22,42	15,51	30,80
	% to total	100,00	12,46	4,06	2,81	5,58
2007	UAH billions	717,08	98,34	30,10	21,22	47,02
	% to total	100,00	13,71	4,20	2,96	6,56
2008	UAH billions	917,04	121,78	37,27	25,58	58,93
	% to total	100,00	13,28	4,06	2,79	6,43
2009	UAH billions	806,55	85,83	34,25	24,50	27,08
	% to total	100,00	10,64	4,25	3,04	3,36
2010	UAH billions	1067,13	116,20	39,59	27,71	48,90
	% to total	100,00	10,89	3,71	2,60	4,58
2011	UAH billions	1120,33	134,82	40,84	28,77	65,21
	% to total	100,00	12,03	3,65	2,57	5,82
2012	UAH billions	216,37	7,25	1,76	2,51	2,98
	% to total	100	3,4	0,8	1,1	1,4

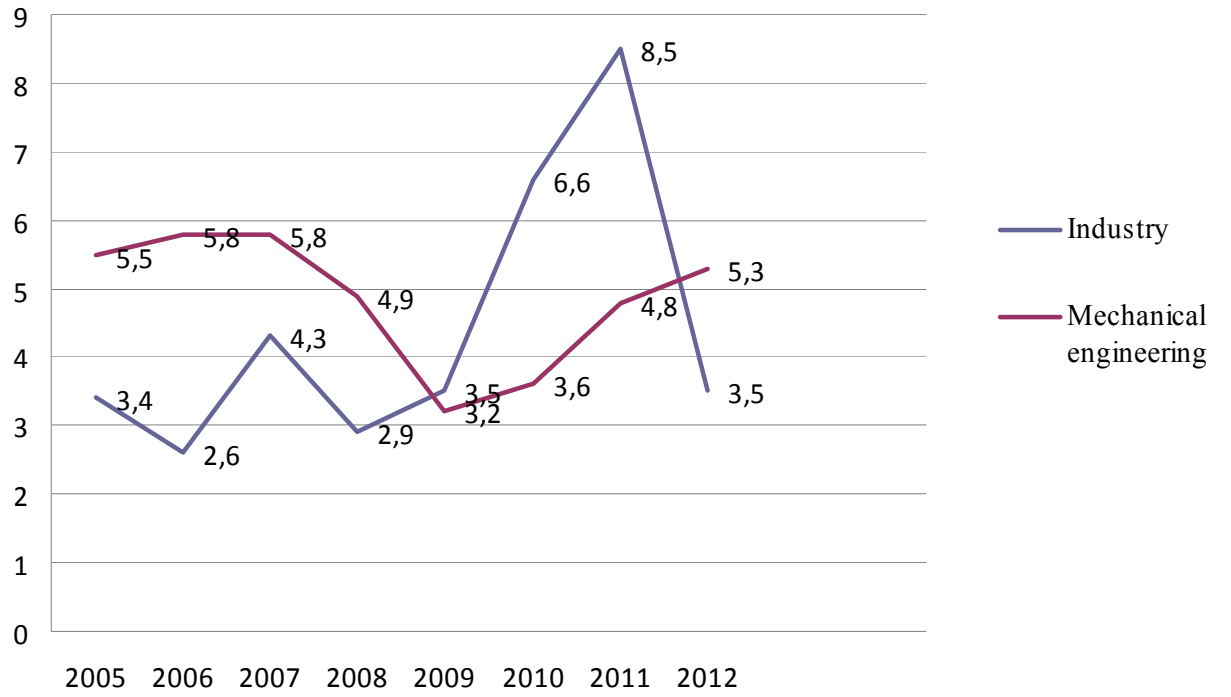

Figure 1. The dynamics of profitability indicators in Ukrainian mechanical engineering in 2005-2012 [18]

In 2011 the mechanical engineering profitability improved significantly as compared not only to 2010, but also to the whole analyzed period in general. Though in 2012 the situation worsened again and mechanical engineering profitability reduced by 5 % in comparison with 2011, and industrial profitability rose by 0,5 %.

The analysis results show negative changes in mechanical engineering resulting from considerable problems faced by engineering enterprises and slowing the development of the latter.

First of all the following problems should be singled out [12]:

- lack of domestic market infrastructure development (the absence of real monitoring, distributor system and financial leasing);
- insufficient paying capacity level of commodity producer, negatively influencing the financial and economic performance of industry enterprises; basic plants producing complex equipment are in difficult situation;
- permanent assets obsolescence of industry's basic enterprises, which have not been renewed for the last 15 years, negatively influencing competitiveness, quality and production price;

- lack of circulating assets and medium-term and long-term crediting imperfection;
- limited domestic demand for domestic produce;
- absence of real funding sources leading to impossibility of reconstruction and technical re-equipment of industrial enterprises and therefore guaranteeing the high quality of the produce, and new competitive equipment production;
- absence of financial mechanisms and instruments rousing interest in innovations, stimulating research and design efforts; low level of domestic enterprises innovation activity;
- domestic enterprises dependence on assembly units, and components delivery from other countries, chiefly from CIS countries;
- substantial losses in productive and personnel potential during the years of destructive crisis;
- lack of state control over monopolists and middlemen leading to substantial growth in the price of materials, energy supply and components;
- considerable lag of mechanical engineering enterprises (as well as the Ukrainian economy in general) in informational technologies use;
- insufficient level of engineering enterprises managerial systems development.

In general, according to development potential, market conditions and multi-versioning models of decision-making enable changes in conditions and results of industrial enterprise functioning. However in many cases the managerial staff of mechanical engineering enterprises cannot cope with this task.

In our opinion further research of mechanical engineering enterprises should be concentrated on the problem of raising the level of their managerial systems development. For this purpose let's consider the definition of management made by a number of scientists (table 4).

Table 4

Definition of the term «management» [1, 2, 6, 15, 17]

Authors	Definition
B.M. Andrushkiv, O.Y. Kuz'min	Management is a purposeful influence on the object aimed at the change of its condition or behavior because of circumstance change.
A.S. Bolshakov	Management is the process of company's resources allocation and flow with a predetermined aim according to a developed plan and continuous activity results control.
E.E. Vershyhora	Management is the function of biological, social, and technical organizational systems, securing their structure and sustaining definite activity order.
S.A. Zhdanov	Management is a cyclic repeatable process of the authority influencing the controlled object based on processing of initial information about the object's condition and situation evaluation. The process logically comprises creating the plan of the aim achievement and corresponding measures, influences are made on the controlled object and their implementation is checked. The plan is amended according to situation changes and object's condition. New influences chosen from many possible variants and definite aims are made to ensure the achievements with optimal resource expenditure.
M.H. Meskon, M. Albert, F.Hedowry	Management is the process of planning, organizing, motivation and control necessary to create and achieve the goals of organization.
S.Y. Khaminich	Management is the total of interrelated actions chosen on the basis of certain information and directed to maintenance or improvement of controlled object functioning according to the set goals.
F.I. Khmil'	Management is a purposeful influence on the process, object or system aimed at maintaining their stability or change of condition.

Most authors consider management as a "process", "action", "function" or "influence" resulting in the purposeful interaction between the agent and the object of management. Some authors pay more attention to the essence of management as a process of resource allocation and flow control. S.A. Zhdanov, S.J. Khaminich consider processing of initial information to be the necessary requirement for management [4, 17]. E.E. Vershyhora reviews enterprise management as the influence of a director on his subordinates when "a director receives, transforms, analyses and uses different kinds of information, because of what he can choose a right influence method" [15]. Thus efficient enterprise management depends primarily on providing timely, objective and exact information. We strongly believe that management process is impossible without it. Information in management is used due to its processing and new knowledge formation. "Knowledge" is understood as reliable, real idea of the system different from probable ones.

There are two forms of knowledge in the system of enterprise management: declarative – fundamental knowledge (how the process is organized) and procedural – pragmatic knowledge (how the process can be changed).

Thus, knowledge is practically confirmed data which enable certain sets of management problems be solved within the enterprise management system. Nowadays a special role is played by managerial knowledge accumulated inside the enterprise on the basis of generalizations made about management problem-solving

experience. This is the knowledge of enterprise personnel and its skills in decision making and implementation. That is why improving decisions quality is possible if based on more reliable and reasonable ideas but it is impossible without deeper knowledge of subject sphere and management system, as well as skills to transform knowledge into results. As a rule management decisions making is based either on causal or functional knowledge. In its turn functional knowledge possesses higher value as they are based on understanding the system functioning laws.

Volume of information necessary for new knowledge formation and management process implementation is determined both by the level of management and management decision importance. It is possible to achieve the goal only in case when there is a chance to work with systematized information containing objective data on economic processes. All information of an enterprise belongs to a special type of resources, namely, information ones. Information resources are the basis for enterprise information support to ground and implement current production tasks as well as prospective ones. We consider the definition of information resources by V.F. Sytnyk to be the most objective, specific and full one. "Information resource is a particular kind of resource based on ideas and knowledge amassed in the process of scientific and technical activity and presented in the form suitable for accumulating, realization and reproduction" [14]. V. Sytnyk also asserts that the term "information resources" is often considered wider than "information" itself. He considers that general information resources in particular consist of computer hardware means, computer software, information workers (analysts, systems programmers, database administrators, multicomputer system developers), users, facilities, data banks and, finally, information itself [14]. S.M. Romashko holds the opposite opinion and considers that different kinds of resources are necessary for information system functioning. The main kinds of such resources are hardware, software, financial, information resources and manpower, though the author singles out the last ones as a separate kind of resources. Hardware resources comprise computers, peripherals, networking and data communications equipment. Manpower of information system is users, administrators and technical maintenance staff and "information resources of the system are the part of enterprise information resources used by information system" [11].

We also do not agree with the second part of information resources definition by V. Sytnyk because we consider that information resources are created processed and used with the help of other resources (material and labour). These information resources are separate objects having different measurements and use methods as it is shown in S. Romashko statement.

On the grounds of scientific resources we can state that enterprise management is a purposeful systematic influence of managing subsystem on a controlled one in the form of sequential operations. These operations are chosen on the basis of information processing results, information resources use, and new knowledge formation aimed at securing appropriate conditions of an enterprise.

Industrial enterprise management activity of any kind concerns managing people forming departments and branches. We consider such activity from the practical point of view to comprise social groups' management. That is why management activity should be viewed as a socially controlled system consisting of interdependent parts contributing to the whole. Thus a conclusion can be made that industrial enterprise management system is total of all subsystems, elements, processes, technologies and their interrelations, along with information resources and knowledge ensuring the enterprise operation and further development.

The first subsystem of management system includes the total of administrative bodies, departments and executives performing the set tasks as well as administrative methods. That is why the given subsystem may be defined as unity of organization, technology and management methods. The author also poses management methods enabling the use of information systems potential and increasing enterprise functioning efficiency owing to high-quality management decisions making. Such methods comprise organizational, administrative, social and psychological, and economic ones.

The second subsystem is informational and intelligent covering the whole management system, because it is impossible to manage an enterprise and its departments without using and delivering information, information resources and knowledge. Management personnel work is intellectual and demands high-quality management information. That is why creation, processing and timely provision of such information at all management levels is the main task of the informational and intelligent subsystem.

The third subsystem is the one of management system development and improvement ensuring the further enterprise development.

Development is a notion characterizing qualitative changes in objects, emergence of new forms of living, different systems existence combined with their internal and external relations transformation (Haminich, 2006). This the higher level of movements and changes in nature and society connected with transition from one quality or condition to another, from the old one to a new one. Any development is characterized by specific objects, structure, source, forms and direction.

The subsystem of development and improvement should ensure the enterprise development irrespective of external environment condition. There is close connection between management system, its subsystems, elements and external environment. Such connection is accompanied by information movement in the form of different information flows leading to either enterprise management system development or its degradation.

Clear management system functioning and management tasks performance means the modern management technologies used only on the basis of information technologies. Management process automation, constantly renewed available software, and global information networks change all parts of enterprise industrial and economic activity radically. Nowadays new information technologies and complex systems have more and more significance

for domestic enterprises. They help to solve the problems from preproduction to production distribution exactly and efficiently.

Mechanical engineering enterprises try to organize management activity using automated information systems in spite of negative depression influence. In recent years increasing demand for information technologies and service led to modern information processing technologies headed for the widest range of tasks. Automated systems and networks of different configurations are created on their base aimed not only at information accumulation, retention, and processing, but also at maximum approach of automated information systems components to the manager and CEO workplaces.

Modern information systems of engineering enterprises ensure supply and financial management, production control, sales management, personnel administration, as well as tax, management and financial accounting automation.

From the point of view of accomplishing definite management tasks information system provides with timely access to information resources, efficient internal decisions coordination and fast spread of management decisions. Also it helps to control the task performance, use previous data saved in database, make changes to database. Fast current and previous data processing, possibility of multiple-choice planned performance forecasting, and raising the management quality and efficiency prove the use of information systems right.

Correct information system components management ensures the system to promote the enterprise development, economic and intelligent potential strengthening. With this purpose there should be defined practical instruments of influence on information system objects. First of all the role of information technologies in the enterprise should be stated, information problems and their connection with the general business development strategy should be found out.

It should be taken into account that while creating the enterprise management system based on modern information systems such rebuilding demands certain (sometimes very substantial) change in management processes in general. In modern condition the absence or imperfection of mechanisms and enterprise management methods, information uncertainty, and dynamic changes in external environment lead to making ungrounded management decisions. Information systems can change the enterprise decision-making hierarchy, reducing the costs for information acquisition and widening the areas of use.

At the beginning of twentieth century the period of information updating was one month or one week. Nowadays most enterprises try to receive the newest information which is updated each day. Even balance sheet turnovers and financial accounts are calculated over such period. Information can be updated instantly in more complicated situations not only in business transaction, but also in information generalization and accounting. Such technologies are invaluable for doing business, providing unlimited possibilities for improving efficiency and enterprise management over a long period of time.

The following properties are necessary for enterprise information system to increase the activity and management efficiency. Among them are: investment savings to minimize information system introduction expenses; reliability to guarantee data safety and accessibility in fault conditions; ensuring efficient data security and protecting from unauthorized access; opportunity of growth; degree of activity automation not only in accounting; interface intuitiveness for the user to understand it without description; possibility to integrate with EDM to realize its function in the system; adaptation to customer's business; moderate price. Such information systems become vital for mechanical engineering enterprises and can be the source of competitive advantage. According to existent estimates, labour productivity can be increased more than twice thanks to modern information technologies introduction into business organization and management [16].

Summary. The research results lead to conclusion that mechanical engineering complex suffered a lengthy destructive recession during the years of economic transformation. Now it adapts to market conditions and develops new industrial markets. These processes were accompanied by serious losses in productive and personnel potential and slowing innovation and investment activity. However during the last 5 or 6 years positive tendencies in mechanical engineering can be noticed. Profits of mechanical engineering enterprises increased; their profitability rose and sales of products augmented. But through the lack of finance the problems in productive potential renewal are solved very slowly, though they are based on innovation technologies and domestic developments use, further commodity production structure change and development of investment mechanical engineering, ensuring final product's competitiveness.

The problems of mechanical engineering development are the part of general economics' problems demanding decisions made on new innovative social and economic development principles.

But certain problems can be solved by separate mechanical engineering enterprise taking into consideration its functioning and reserves peculiarities. One of the problems singled out in the research is mechanical engineering management system development based on information systems. Such systems ensure industrial and economic activity automation and favour enterprise management system effectiveness increase and further development.

New tendencies in economic development of countries leading in the world economy and experience of many domestic enterprises prove that the use of information system industry achievements in enterprise management is a requirement and a component of management process success. Strategic prospective of enterprise activity depends on the information systems ability to function.

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