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TECHNOLOGY REENGINEERING AS A TOOL FOR POST-CRISIS READJUSTMENT OF MECHANICAL ENGINEERING ENTERPRISES IN UKRAINE

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The article addresses conceptual issues of technology reengineering of problematic enterprises in the mechanical engineering industry. Technology reengineering is proposed as a basic tool for readjustment of post-crisis mechanical engineering enterprises. Special consideration is given to the backbone and the constituents of technology reengineering.

Keywords: *readjustment, technological processes, technology reengineering, innovative reorganizations, competitive strength, mechanical engineering*

Problem statement. The processes connected to the formation of market relations in the Post-Soviet space have entailed significant structural changes in the industrial sector of economy. The mechanical engineering industry has undergone drastic changes. Presently, the main characteristic of the Ukrainian mechanical engineering is its heterogeneity manifested by the use of a limited number of new progressive technologies along with the wide use of obsolete technologies. At the present stage of development, the foreground task is recreation of the mechanical engineering complex which forms strategic benchmarks for the whole industrial sector of economy. Modern scientific and technological progress is unrealizable without establishment of high-tech enterprises based on the latest technical solutions, starting from mechanization and automation of key processes of organizational and manufacturing activities to informatization of the finest functions of human relations related to management activities. Achievement of these goals requires creation of a well-defined interaction between the government, business, science and education through the use of effective tools for innovative development.

Technological readjustment of mechanical engineering manufacture cannot be performed without modern computer-aided manufacturing tools. At this, from one side, the real condition of domestic manufactures must be considered, while from

another side, the trends in the development and modernization of the world population of mechanical engineering must also be taken into account. Technological corporations have incentives to use technological innovations and modern business-technologies for penetration of emerging markets. Typical manifestations of these trends are seen in Russia, Ukraine, Bulgaria, and other states. At present, the first stage has been completed, aimed at the development of new marketing outlets by means of establishment of own representative offices with finished-products storage areas and service centres able to deliver the equipment of any configuration within 24 hours. Only a competitive manufacture with appropriate government support can withstand this.

Analysis of recent researches and publications. The issues of readjustment of problematic enterprises were addressed in a number of publications. A significant contribution into investigation of the problems of readjustment and reengineering of the business processes of an enterprise has been made by domestic and foreign researchers, including N. M. Abdikeev, L. Brecht, N. Venkatraman, T. Hess, S. Yu. Glaziev, T. Davenport, S. V. Ildemenov, G. Johansson, A. Kleiknecht, M. Klein, S. S. Kuznets, T. I. Lepeyko, D. S. Lvov, R. Manganelli, V. G. Medynskiy, G. Mensch, L. N. Ogoleva, Ye. G. Oikhmann, E. V. Popov, M. Robson, P. Romer, P. A. Strassman, S. V. Rubtsov, Yu. F. Telnov, F. Ullach, R. Foster, M. Hammer, J. Champy, J. Short, etc. Analysis of the current scientific research in the field of readjustment and reengineering of enterprises, showed that there is currently no methodological foundation for diagnostic analysis of functional and technological bases of mechanical engineering manufacture to perform the necessary reengineering reforms, considering their interactive nature. Not yet solved is the issue of the development of methods for economic evaluation of the synergetic effect of reengineering reorganizations. Individual theoretical questions require further clarification.

The aim of the study is to analyse the process of reengineering and to form a conceptual basis of technology reengineering as an effective tool for readjustment of mechanical engineering enterprises.

Main material. The purpose of the strategic management of a modern enterprise is to ensure its long-term development strategy on the innovative basis. Therefore, the management of an enterprise should be based not on partial improvements of business processes, but rather on radical changes in the entire technological base. Technology reengineering should be considered as one of the most effective tools for post-crisis readjustment of mechanical engineering enterprises.

The term ″technology reengineering″ is fundamentally inextricably associated with the term ″innovation″ as it was defined by J. Schumpeter in his innovative theory of economic development [9]. According to J. Schumpeter, innovation induces radical changes directed to implementation of the improvements which are much

more significant than those which could be provided by simple changes; these improvements affect all areas - technological, social and organizational, thus creating conditions for further economic development of an enterprise.

Economic theory recognizes that innovations and, consequently, technology reengineering, are the key drivers of economic growth. This conclusion provides the basis for innovative economic theories generated by S. S. Kuznets, G. Mensch, A. Kleiknecht, D. S. Lvov, S. Yu. Glaziev, R. Foster, P. Romer, etc. These theories have further developed earlier conclusions about the causes of economic growth [14].

The term ″reengineering″ has been first introduced by M. Hammer and J. Champy. They defined it as a fundamental rethinking and a radical redesign of business processes required to achieve dramatic improvements in critical contemporary performance indicators: cost, quality, service and promptness [11]. Shortly after this, a book by G. Johansson was published, where the term ″reengineering″ is defined, first of all, as an achievement of superiority in one or more of the value indicators, for which the market clearly recognizes the superiority of the relevant company; at this, the result achieved is reflected in a disproportionately large and maintained over time gain of the market share owned by this company [13]. A similar approach has been proposed by T. Davenport and J. Short [12], who called it a redesign of business processes and put the concept of "business process innovation" at the centre of the discussion.

Currently, the following basic types of reengineering are defined: bio-reengineering [3], preventive reengineering, inter-industry reengineering, joint reengineering, risk-engineering [1], technology reengineering, construction reengineering, reengineering of organization and manufacture, social reengineering, innovative reengineering, comprehensive reengineering [6], reengineering of financial business processes [5], ex-reengineering [2], forward and reverse reengineering [7], etc. Although prioritization and interpretation of the approaches are different, the importance of the three factors determined by M. Hammer is universally accepted. These factors include process thinking, radical change, and the potential of information technologies [11].

The technology reengineering should be understood as a complex procedure, which involves the development or purchase and sale of new research and development (R&D) work and new technologies, production experience, staff skills and knowledge, and the know-how, with the aim to further implement new production methods and to promote their diffusion in the manufacture for commercialization of new products and new services, expansion of presence at the market and strengthening of competitive advantage, or redesign and upgrading of the existing technologies [6].

Technology is an important factor of production, and for an industrial enterprise it serves as a tool which allows achievement of the highest competitive advantage.

The introduction of new advanced types of technologies enhances the competitive strength and the quality of the manufactured products, ensures a strong competitive position and market leadership of the company, and increases the rate of return.

The classical concept of technology reengineering involves a revolutionary, abrupt development of the scientific and technological potential of an enterprise. This can be explained by the fact that modernization and evolution of the basic technologies, which until recently were sufficient for successful achievement of the objectives of improving the performance of an enterprise, in the end, with the improvement of technologies, their transition to the stage of maturity and the market saturation, become ineffective. Deep inside the existing technological structure, breakthroughs of some principally new technologies occur, and the evolutionary type of technological development is replaced by the revolutionary one.

Thus, the technology has turned into a driving force and became the most important competitive advantage which defines the strategic future of an enterprise. P. Drucker states [4] that a prerequisite for survival in the era of competition under conditions of globalization, open markets, dominance of transnational and multinational corporations, unique products and basic innovations, is the leadership in regard not to the "close competitor", but to the world market leaders. An effective methodology for identification of the world market leaders, leading technologies and organizations, which is successfully used by Japan, Korea, Singapore, China and other countries, is the benchmarking methodology.

M. Hammer and J. Champy, citing as an example the experience of IBM Credit, Ford, Kodak, Chrysler, American Express, Texas Instruments, Duke Power and Deer, insist on the use of the latest technological capabilities to achieve fundamentally new goals. They suggest to use the so-called inductive reasoning to find some new, unknown technological capabilities, emphasizing that as a "new" can be considered only that technology which is not yet on the market, and only those enterprises can succeed, which request the development of the necessary for them technologies long before these technologies appear on the market [11].

The idea of the projects for reengineering "from scratch" has found its adherers, however, at the same time it was subjected to a harsh criticism. In particular, it concerns the feasibility of introduction of principally new technologies. The existence of the developed technologies and the availability of a standard sample of core technology, reflected in inertia of the current system, often hinder the introduction of alternative and more advanced technologies. The second target of criticism has become the "mechanism" of the reengineering concept, where a social factor was absent. Despite the threat of staff reduction in the event of success of a reengineering project, the concept implied a high degree of interest from rank-and-file employees in the results of reengineering, as well as flexibility and involvement of the overhead personnel in this process. In practice, however, it turned out that organizational

structures do not allow introduction of innovations within the framework of short-term projects, since radical changes usually require refusal of the well-established traditions, values, corporate interests, informal power structures and established relationships within the organization, which all cannot be performed without a protest from the personnel.

Thus, it is incorrect to consider the technology reengineering as nothing else but only the use of a new technology. The technology in a reengineering project is just one of the driving forces of radical changes. In practice, reengineering includes also other elements, such as business processes, proper use of the principles of process management, use of the methods of organization and total quality development, as well as modern methods of motivation and personnel management. According to D. Sakhal [8], in some cases of technology changes, the role of the employee, the quality of its training and assimilation of the yet accumulated experience and knowledge, are much more important than the equipment used. This idea is confirmed by intensive economic development of the South-East Asia countries (South Korea, Taiwan, Hong Kong) whose technological mode is connected with the borrowed, but fundamentally new technological systems focused on the final stages of the manufacturing lifecycle and cheap high quality labour.

The Socio-Technical Systems School established by the Tavistock Institute of Human Relations in the 50's and 60's of the twentieth century, was the first to drew attention to the need to take into account also social and not only technical aspects of the system. Without taking into account and accordingly managing the social aspects of the changes, it will never be possible to unlock the full potential of technological capabilities. Therefore, the changes in technology and business processes arising as a result of new technologies must be accompanied by the changes in the policy of human resource management [7].

It should be noted that M. Hammer and J. Champy themselves admit that more than one half of the projects on the reengineering of business processes have not been completed or have not achieved the desired goal [11]. Not least important here was the imperfection and incompleteness of the methodology of business processes reengineering. It did not reflect the full complexity of reengineering projects, and often in practice the developed methods were incompatible with each other.

T. Hess and L. Brecht [12] have analysed 15 reengineering methodologies: Action Inc. (Action Methodology), Boston Consulting Group (Reengineering), Davenport (Process Innovation), Diebold Deutschland GmbH (Geschäftsprozessoptimierung), Eversheim (Prozessanalyse und -gestaltung), Ferstl/Sinz (Semantisches Objektmodell), Hammer (Reengineering), Harrington (Business Process Improvement), IBM Unternehmensberatung GmbH (Continuous Flow Manufacturing), Johansson (Break Point Process Reengineering), Malone (Handbook of Organizational Processes), McKinsey&Company (Core Process

Redesign), Ploenzke AG (Geschäftsprozessanalyse), Österle (Promet BPR) и Scheer (ARIS), and came to the conclusion that, despite the fundamental differences in certain aspects, there are some factors, the importance of which is recognized by each of the studied methodologies. Considering technology reengineering as a classic case of the short-term innovative project, the following phases can be defined, which it passes like any other project: initial phase, phase of development, implementation and completion phases. These are the common features of all methodologies. The differences begin with the goals set for the project, and the principles underlying the redesigned processes.

Based on the analysis of the existing business processes reengineering methodologies and their practical application, the authors propose a methodology for implementation of technology reengineering and define the following stages of implementation.

Social engineering: personnel motivation, restructuring of personnel´s work, training and re-training, establishment of the project team (selection of the process owner, team leader, communicator, external consultant, facilitator, and team members including the chairman, navigator, idea man, supervisor/evaluator, executive worker, supply agent, a collectivist-peacemaker, and outsider).

Visualization of the image of a future company and the surrounding world based on introduction of a new technology. At this stage it is necessary to develop a new perspective on the company and to formulate it in terms of specification of the main goals of the company, based on its strategy, customers´ needs, general level of business in the industry (determined based on the results of the benchmarking carried out) and the current state of the company. In the course of the marketing express diagnostics, the principles of inductive reasoning should be kept in mind: searching for new capabilities of technology, the efforts should be focused rather not on the client´s desires but on his needs.

Assessment of production systems of an enterprise during retrospective reengineering. At this stage, the efforts are focused on investigation of the technologies applied at the enterprise and their properties, on isolation and characterization of individual processes, evaluation of their quality, analysis of scientific basis of technological development, strategy, technical policy and strategy of technological development, production facilities and technological, age and reproductive structure of fixed capital assets, employee productivity and efficiency, structure of output and renewal of products, hierarchy of the objectives of technical, scientific and technological development, organization of measures of scientific and technological development of manufacture, principles of production systems organization, etc.

Implementation of forward engineering:

- Identification of technological processes for the purposes of reengineering;

- Diagnostics of the selected processes, their understanding and description;
- Development of the technology replacement process in technology reengineering;
- Development of an information system providing support to a new business by means of information technologies.

Pilot implementation and replication if successful.

Completion stage. This stage includes summarizing of the overall results and assessment of effectiveness of the technology reengineering project.

It should be remembered, that during the entire period of the technology reengineering project implementation, at the end of each stage, the financial stability of the enterprise should be monitored. The enterprise should continue to function while maintaining a balance between the existing manufacture and the one emerging as a result of the technology reengineering project implementation.

The changes arising in the course of technology reengineering, affect not only manufacturing systems but all aspects of the industrial enterprise [11]: changes in positions and the appropriate employees take place; linear logic of work is replaced with logical procedure, standardization is turned away from and instead different versions of one process are developed, the number of audits is reduced and instead aggregate or deferred control measures are used; combinations of centralized and decentralized actions predominate, etc.

Conclusions and prospects for further development in this direction. Summarizing theoretical foundations of the essence of economy of technology reengineering in the context of strategic management of competitive strength of an industrial enterprise brings us to the following conclusions.

The concept of reengineering has played an important role in the revival and development of such foreign companies as IBM, American Express, Ford, Chrysler, Texas Instruments, Duke Power, Deer, and this concept achieved rapid success in business and popularity among people. From such examples it becomes clear that a central strategy of functioning of a particular organization under the conditions of market economy includes orientation of this organization towards reengineering, restructuring, innovation and investment activities.

In accordance with this, technology reengineering should be considered as an effective mechanism for readjustment of post-crisis enterprises based on radical changes in the currently applied technologies. It should be performed in conjunction with social and innovative engineering, reengineering of business processes and monitoring of financial stability of an enterprise.

A fundamental change in the technological mode of production and in its impact on the economic potential of the society, serves as a measure of the current economic development. Revolutionary, abrupt development of scientific and technological progress is combined with evolutionary social and organizational and management

innovations. The cumulative effect of introduction of radical and associated evolutionary innovations leads to formation of a new type of manufacture, a new investment structure and a new type of market behaviour of an enterprise. All these factors become the objects of technology reengineering.

Formation of the methodology for technology reengineering is not yet completed. Based on the methodologies developed by M. Hammer and J. Champy, and the Kodak´s methodology, taking into account the need to connect it to the enterprise strategy as was proposed in the methodology developed by R. Manganelli and M. Klein, the authors offer their own version of the technology reengineering approach. The essence of this approach lies in the emphasis on the social aspect of implementation of a reengineering project. The methodology which takes into account the complexity of technology reengineering projects, is the key factor of a successful implementation of the project and the resulting acquisition of an innovation monopoly by the industrial enterprise.

Being aware of the heterogeneity and imbalance of economic development, more clear and consistent efforts should be made towards deep reconstruction and upgrading of manufacture, with simultaneous replacement of outdated technologies with new ones. Technology reengineering will allow creation of conditions for priority development of the fifth and the emerging sixth waves of innovation on the territory of Ukraine, which in the future will help the country to join the large scale transformation taking place in the global economy.

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