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Economic, Scientific and Technical Factors in Quality Management

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The article examines interaction of economic, scientific and technical factors in quality management training including not only development of new approaches, but also design of integrated systems based on the principles of total quality management. In order to estimate efficiency of interdisciplinary projects, multi-criteria and multi-model approaches are considered essential.

Key words: quality management, integrated systems, total quality management, scientific and technical factors, economic factors, estimation of project efficiency, multi-criteria approach, multi-model approach.

By the end of the 20th century, people have come to understand that quality management rests on the strategies and tactics to achieve economic well-being of a certain employee and society in general.

The 21st century was rightly called a Century of Quality by UNESCO. The current approaches to quality management do not only concern engineering process, but also direct and control an organization and society as a whole. In fact, quality is an integral notion that involves engineering, technical, economic, social, philosophical and other aspects, as well as their interaction. Today, quality management is of great importance as it is regarded as a strategy to improve economic efficiency within the international integration frame.

Different market processes stipulated the origin of various quality management systems based on the principles of Total quality management (TQM). The modern toolbox to enhance quality and productivity in business has been recently enriched by such approaches as Project Management, benchmarking (a method to compare key metrics), teaching organization theory, Balanced Scorecard, the concept of "6 sigma", Business Excellence, Total Productive Maintenance (TPM) [1, p. 82].

Managers of the companies have started to use more often various methods of analysis and problem solving which encourage and develop creativity. Benchmarking continues to grow in popularity and is used to enhance economic efficiency of organizations. Project management that allows creating flexible project-based and horizontal organizations also develops, though, not as rapidly as desired. Among the approaches that are likely to grow in popularity, Balanced Scorecard and Knowledge Management are worth mentioning. The requirement for a life-long learning has become an inevitable reality.

It is obvious that the basic concept of Scientific Management is directly dependent on the quality policy, which, in its turn, is the basis for effective implementation of other strategies of a company. Today, quality management is gradually becoming the key method to control and direct business, i.e. management of the fourth generation [2, p. 25].

The end of the 20th century witnessed a transition from "Mass production" to "Lean production". The beginning of the 21st century is viewed as a period of a new type manufacturing, called by a number of authors "Agile Manufacturing". Lean production, agile manufacturing, and simple use of process approach in line with the standards ISO 9000 can eliminate the borders, first of all, between organizations, then, between countries [3, p. 16].

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The competitiveness of an enterprise or company directly depends on the quality of management. International standardization of management systems and their integration are one of the methods to ensure sustainable development of an organization.

Therefore, design of the integrated management systems (IMSs) has become rather popular. IMSs create the conditions for further improvement of the management system. However, IMSs should not be identified with the system of general management which unites all activities of an organization. Even in the case of implementing all existing universal and industry-specific standards, IMSs are not the same as general management of an organization as IMSs do not include financial management, staff management, innovation management, risk management, management of value documents, and etc.

When designing IMS, principles of sustainable development and continuous business processes with regard to the risk assessment are basically used. These principles are specified in ISO 9004:2009 "Managing for the sustained success of an organization – A quality management approach", ISO 31000:2009 "Risk management. Principles and guidance", ISO 31010:2009 "Risk management. Risk assessment techniques", BS 25999-1:2006 "Business continuity management. Code of practice", BS 25999-2:2007 "Business continuity management. Specification".

Modern marketing has created a new type of competitiveness – intellectual capital competitiveness within the international frame. In the developed countries, the maximum growth of the national income is secured due to the forward-looking development of science, i.e. knowledge growth. The import of technologies is significantly more effective than the import of products, while the import of intellectual capital is several times more efficient than import of technologies. Therefore, a number of developed countries focus on import of intellectual capital and professionalism making it a part of the state policy.

Modern quality management can be definitely referred to relevant activity. It is proved by the fact that it covers various processes of product lifecycle and includes numerous methods, technologies, and approaches which are based on different design, analysis, and forecast techniques [4, p. 162-163].

Throughout the history of management theory and practice development, there is still debate on the importance of technical and humanitarian issues in management. The current conditions resulted from the need to facilitate the transfer to knowledge-innovation economy urge to solve the problems related to the effective interaction of scientific, technical, and economic factors. Thus, search for the rational combination of technological and economic potential is a key task of quality management [5, p. 284].

Technological potential is secured by objective physical, biological, chemical and other terminal parameters. At any given time, the terminal parameter is defined by the gap between the achieved level of technical efficiency and the theoretical limit to the efficiency of the given technology. In addition, technical efficiency or technical level is defined on the basis of the parameters which have high customer value and do not directly associated with the technical advancements.

Technological efficiency is necessary but not sufficient condition for commercial success. The efficiency of a new product is comprised of two components: technological and cost efficiencies. Therefore, a new product will be effective if two types of efficiency are rather high. When a new product is technologically effective, but meets no demand, the total efficiency is negative.

Implementation of the interdisciplinary project should provide a given level of profitability, planned outputs, acceptable risk level and financial stability of an organization. Methodologically, it necessitates the use of multi-criteria approach for assessing interdisciplinary projects.

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In order to assess the projects via multi-criteria approach, it is necessary to use a set of partial models followed by multi-criteria optimization of decision-making process. Methodologically, this indicates the shift to polymodel principle of comparative analysis of variance for interdisciplinary projects.

Logically, the essence of the polymodel assessment and construction of the corresponding complex model for certain alternatives of interdisciplinary projects is reduced to an adaptive design and conceptual substantiation of the methodological provisions of a multivariable assessment. In addition, specific properties and corresponding conditions of the assessment should be also considered.

In our opinion, mechanism to evaluate and select the most effective projects should consist of the following units: evaluation of project technology, evaluation and taking investment decisions, evaluation of network (corporate) interaction, comprehensive evaluation and selection of projects.

Polymodel assessment of investment decisions rests on the complex structure of the general model of evaluation and decision-making. It consists of a number of partial models to perform multidimensional analysis of the options and make the decision on the basis of the criterion of preference in the process of multi-criteria optimization. Thus, the unit of evaluation and taking investment decision involves the following models: model of economic evaluation of projects, corporate evaluation of projects, risk assessment model, model of multi-criteria decision analysis based on the designed criterion of preference.

The first three models can be regarded as partial models, while the model of multi-criteria analysis and decision taking – as a general model for decision optimization.

The algorithm of finding the desired solution consists of a number of stages. Firstly, polymodel assessment of projects is performed in order to redefine the problem of optimizing the choice of the preferred project version in accordance with the relevant criteria and scientific, technical, and economic factors. The next stage is a multicriteria optimization of decision-making process. The stage involves the aggregation of criteria for project assessment and expert multi-criteria evaluation of alternative projects. A final decision on the choice of the preferred project is taken at the final stage of the algorithm.

Thus, the objectives of process management necessitate the use of multi-criteria decision-making methods. To a certain extent, they are often generalization of one-criterion methods. However, most of the management decisions are aimed at achieving a number of, often conflicting, goals. Hence, it is almost always difficult to reduce the problem of finding optimal solution to the traditional one-criterion methods. Therefore, enormous attention, both in theoretical and practical sense, has been recently paid to the development of new methods to evaluate and optimize management solutions. In this respect, the theory of fuzzy set should be mentioned first. Along with the calculus of variations, solution of differential equations, linear programming, Pareto optimization techniques and finding of the planes of indifference are frequently used.

It has been proved that the required complex approach to quality management is secured in the case when systems, statistical and engineering methods are in line with the appropriate production relations. However, the proposed set of methods has not been applied in quality management yet [1, p. 82].

In present conditions of business and enterprise management, knowledge, both in modern production technologies, i.e. production management, and quality management, i.e. quality management efficiency, is becoming more and more essential. This constitutes a key parameter in developing competitive advantages of enterprises and organizations. In this respect, students should possess knowledge in quality efficiency in order to make rational management decisions in the research area.

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Interdisciplinarity in Practice-Oriented Training of Bachelors in Line with the CDIO Initiative

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In the context of modern constantly changing realm the successfulness of technical HEIs' graduates is determined not only by their current knowledge, but also by their ability to adapt to these changes. This article is devoted to the efforts of the Saint Petersburg Electrotechnical University "LETI" and namely the Faculty of Information Measurement and Biotechnical Systems (FIMBS) on implementing the CDIO Initiative approaches for development of the required students' competences.

Key words: CDIO, engineering education, quality of education, interdisciplinarity, instrumentation technology.

One of the key factors influencing formation of specialists on any stage of educational process is the motivation of a student. Therefore, HEIs that want to increase the demand for their graduates have to pay significant attention to enrolling motivated school graduates, bachelors, master students, and PhDs. Throughout the study process all of these types of students have to have certain understanding of the connection between each step they make and the final result they can achieve; in this case, it is the successful employment [1, p. 166].

Working with school students

The introduction of a new enrollment procedure in Russian HEIs, which is based on the results of the Unified State Exam, has significantly changed the approach towards enrollees. Previously, in order to apply for admission to university prospective students had to come to an HEI, meet the Admission Board and exam administrators, which gave both enrollees and HEI an opportunity to get to know each other to some extent. The current situation is conceptually different, since the admission becomes accessible even by sending the documents via mail. In this case, the understanding of prospective students' motivation to receive the education in a certain HEI on a certain major becomes perceptible only during the educational process itself. The solution to this problem is active interaction between an HEI and its prospective enrollees both in the city and in other regions or countries.

LETI, and the Faculty of Information Measurement and Biotechnical Systems in particular, spend significant financial and labor resources on career-guidance activities for enrollees (Fig. 1).

The aim of this process is to get enrollees acquainted with peculiarities of studying at this university and faculty, and to attract to enroll at LETI those prospective students, who are interested in receiving engineering education in this field. By going through a consecutive set of events each prospective student will be able to choose his/her future educational path deliberately and, moreover, foster extra skills of communication, team work, as well we adapt to the upcoming learning process at an HEI [1, p. 167].

Features of educational process

The optimization of educational process that aims to increase the demand for graduates within the real sector of economy is a complex multifactor problem. The LETI Faculty of Information Measurement and Biotechnical Systems, when solving this problem, focused on the requirements

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