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Information and Communication Technologies in the Product Quality Management System of Industrial Enterprise

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Abstract

The article investigates in-depth the theoretical provisions for the construction of modern product quality management systems, providing for the optimization and transformation of individual production and economic processes to a higher quality level, as well as the functions integration of enterprise management system and product quality management system; such integration is carried out on the basis of knowledge, information and communications, which are the basis of external integration processes of the enterprise. This provided an opportunity to develop a scientific and methodological approach to the formation of an adaptive quality system capable of producing high quality products over a long period

of time. The generalization of practical aspects of the research provided an opportunity to build an algorithm and determine the tools for the formation of an adaptive product quality management system using modern computer technology for effective information support.

Keywords: Product quality, Quality management system, Elements of control system, Adaptive quality management system, Economic and mathematical modeling, Computer technologies.

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Introduction

Quality of products and services is a complex concept that covers the complex phenomena of production processes and the relationships of their participants (Bezrodna, 2017).Therefore, in a broad sense, "quality" is a set of characteristics of an object related to its ability to meet established and anticipated needs. As rightly noted by V.V. Yefimov, the selection of the main periods in filling the content of the category "quality" by scientists S.P. Spiridonov (2000), indicates that each subsequent concept of quality complemented and expanded the previous concepts and embodied the requirements of the appropriate socio-economic level of development (Fig. 1).

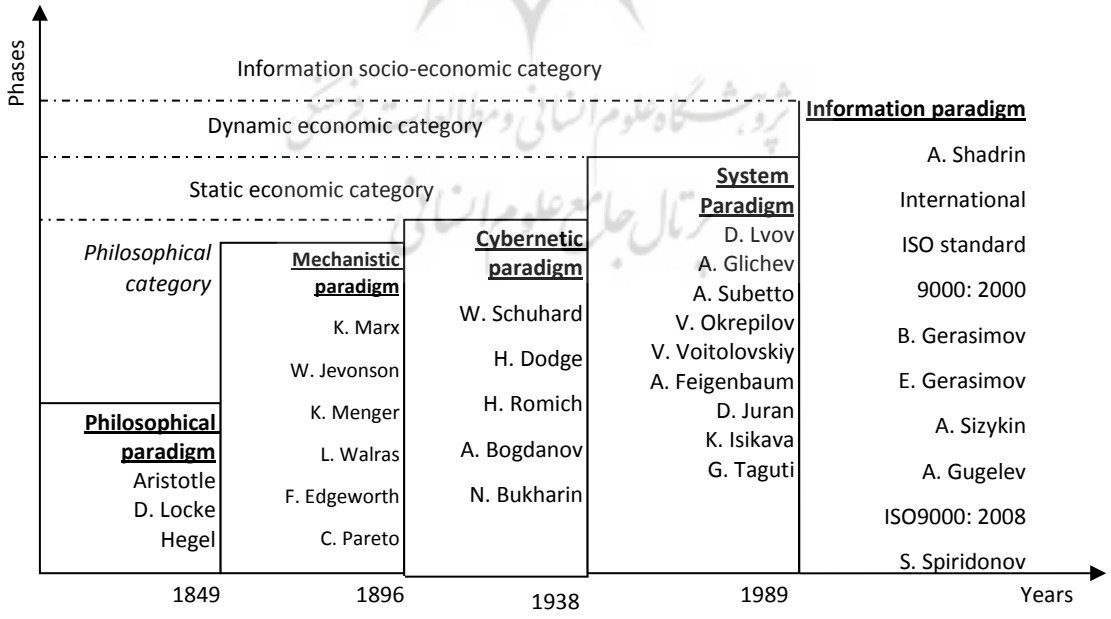


Fig. 1. Stages of evolution in the formation of the category "quality" (Efimov, 2000; Zhirnova, 2014 ; Maksimova, 2014)

All concepts and approaches in the interpretation of quality are closely interrelated, respectively, they do not have clear features and criteria for differentiation (Jiong, 2010 ; Voynarenko, 2015 ; Gabor, 2015 ; Geets, 2016 ; Zhirnova, 2016). However, in our opinion, the basis for understanding quality at the macro and macro levels, given the development of the information paradigm, advocates its disclosure as an informational socio-economic category. The experience of successful domestic and foreign firms shows that for each economic entity the dissemination of information about the quality of products or services acquires a unique significance in making a profit, is a key element of the development strategy and innovation processes implementation.

The results of research of modern scientific statements and practice of their implementation confirm the correctness and relevance of the conclusions that product quality embodies not only the set of properties of certain objects or objects, but also the system of economic relations between producer and consumer arising in the production process, the formation of its values and abilities to meet consumer demand, which are generally determined by the level of scientific and technological progress implementation in the field of national economy (Mapanga et al., 0218 ; Marinenko, 2016 ; Glushchevsky, 2016 ; Hoop, 2016).

However, the intensification of competition for world markets, limited production of certain products and overproduction of others encourage the scientific search for the essential content of such a category as product quality, which reflects the main direction of socio-economic development of today.

Methodology

Substantiation of scientific and methodological approach to the formation of an adaptive product quality management system of industrial enterprises

The industrial complex product quality ensures the implementation of the most important functions of the country's economy. Firstly, the product quality level and its consumption tendencies indicate the level of development of equipment, technology, information exchange, use of computer systems, innovations' introduction and efficiency of the enterprise management system, including the product quality management system.

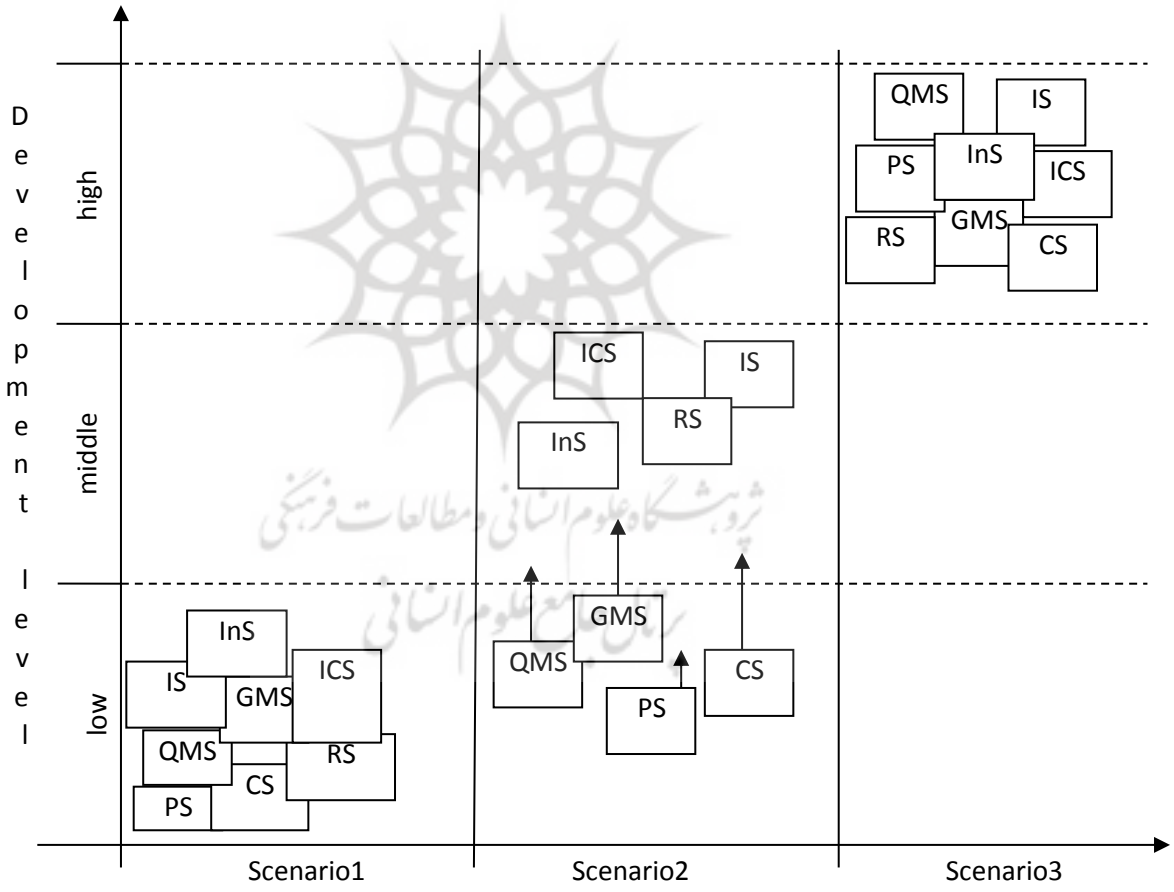
Secondly, product quality is the most important qualitative indicator of the enterprise performance, on the basis of which management decides to implement appropriate measures in both spheres of product quality management and the enterprise management in general.

Thirdly, product quality reflects the enterprise ability to form a system of knowledge and create effective mechanisms for its use.

Fourthly, the level of product quality reflects the success of the enterprise information and communication system and the mechanisms of using information support taking into account the qualification level of the enterprise staff (human potential, knowledge) (Andersen, 2006 ; Zlobina, 2006 ; Drabanich, 2013).

And finally, the products quality and its consumer demand determine the environmental friendliness level of production, safety of consumption, stipulate nation's health and act as a system-forming component of the state's economic security (Oliinyk, 2017). The enterprise products quality is formed under the influence of a number of factors depending on the current quality management system, and either directly or indirectly determining the conditions of its operation. Each factor arises under the influence of various economic systems interaction, which causes new phenomena in their functioning, integrated interaction and synergistic effect. Note that the level of each system development may be different, as well as the influence of relevant factors.

Based both on the performance analysis of industrial enterprises of Khmelnytsky region, and on selected key dominants, we will consider possible scenarios for the interaction development of the enterprise main systems: quality management, general management system, production, regulatory, intellectual, innovative, communication, and information and computer systems (Fig. 1).



IS – intellectual system; InS – innovation system; ICS – information and computer system; GMS – general management system; QMS – quality management system; PS – production system; RS – regulatory system; CS – communication system

Fig. 1. Enterprise economic systems and their interaction (Zhirnova, 2014 ; Drabanich, 2013 ; Voynarenko et al., 2018)

Based on the theoretical study and identification of economic trends in society, we havedetected the following systems that most fully reproduce these trends. Among them are: changes in the competitive advantage essence, rapid computer technology development, improvement of regulatory system based on the development vector choice; building a progressive society on the grounds of a set of personality traits: self-control, continuous development, integrity, purposefulness, efficiency, effectiveness and productivity; outlook formation of the new economic personality; new content of TQM principles.

The overall quality management system begins with the top management, which ensures the implementation of the strategy according to which the company must achieve a higher development level in the future. Any of the systems can be a starting point of such development, but the product quality management system role is decisive.

Traditionally, the following levels of system development are distinguished: low, medium, and high. The low level of system development (scenario 1) is under the influence of system-forming factors and synergetic effect, and it requires a change in the development of all systems, however, their simultaneous development may not always be the same (scenario 2). The development of at least one or more of the systems inevitably leads to the development of all other systems (scenario 2), as the relationship between the systems occurs through the integration of principles, methods, processes and other components.

The integration interaction of the above systems on the example of enterprises is provided by a range of tools such as: organization and conduct of the external environment comprehensive study; identification and assessment of trends in the market environment; identifying and forecasting the development of consumer demand for products. Elements of each of the systems should be used for the implementation of the activities mentioned above. These involves the formation of integrated management methods to substantiate managerial decisions, and allows you to solve more complex problems to increase the enterprise competitiveness. As a result, there are new factors to stimulate economic processes and new features of both the overall enterprise management system and the product quality management system, as well as the rest of interacting systems. It is due to the above properties of the systems and their integrated interaction that the adaptive capabilities of the product quality management system are manifested.

In its turn, the integrated interconnection of systems is provided (and further developed) by information flows, which are united by balanced social and economic interests and their stimuli, capable of generating new stages of different flows and interconnections.

We believe that the integration of systems cannot happen spontaneously, so there is an integration of goals, resources, functions, processes and other components that are subject to a well-grounded aim, and thus they ensure the implementation of adaptive mechanisms of product quality management system. Thus, from the standpoint of systems theory, the quality management system of the enterprise should be considered as a holistic system, the integration processes of which are subject to strategic goals determined by the integrated

vector of enterprise systems development, which is formed according to its resource potential, development potential and adaptation capabilities. In its turn, the integrated vector of enterprise systems development is conditioned by its integral system formation, the properties of which depend on the type of subordinate systems. Thus, all enterprise systems are aimed at achieving its strategic goals. To this end, system-wide strategic goals are formed, which must be implemented in a clearly defined sequence and with a reasonable level of development. Accordingly, the development directions also become a system, for which the potential, resources, constraints, adaptation needs and target functions (taking into account the balance of interests, coherence of interactions and priorities of development directions) are determined, corresponding to the target function of the integrated vector of enterprise development. The content of the vector depends on a set of factors that determine a particular type of enterprise development and the direction of systems development.

Since the purpose of the economic systems interaction is to achieve the strategic goals of the enterprise with adaptation to possible changes, each system can correspond to a separate vector determining its strategic development. Therefore, each vector forms the impetus for development and activates a set of systems (intelligent, information and computer, innovation, general management system, product quality management system, production system, regulatory system, and communication system) and their processes with different degrees of integration. This indicates the multidimensionality and complex nature of the vectors. In turn, each of the vectors forming the system can be considered both as a result and as a factor of development.

It can be concluded that the adaptive product quality management system can be represented as a multidimensional vector that determines the development of the system itself, their interconnected systems, and integrated elements (processes), the model of which (on the example of economic production processes) is presented in Fig. 2. As can be seen from the figure, a comprehensive approach to the use of material resources, information, knowledge, innovation at the initial stage, allows you to get the planned quality output to fully meet the needs of consumers, which is the main strategic direction of quality management system (Jiong, 2010 ; Gabor, 2012).

Therefore, the vector of strategic development of adaptive integrated product quality management system can be described by the expression:

$$VR = \bigcap_{i=1}^{K} VS_i \tag{1}$$

where VR is the vector of strategic development of adaptive integrated product quality management system, VS_i is the vector of development of the i-system of the enterprise, K is the number of systems of adaptive integrated system of the enterprise.

Here a certain VR vector provides a certain target state of the adaptive integrated product quality management system SD, as a result of its formation.

For each system Sia system P of development processes p_j is formed in a certain direction of development, the total number of which is N:

$$P \subseteq \{p_1, p_2, p_3, \dots, p_N\}, \; p_j \in P \tag{2}$$

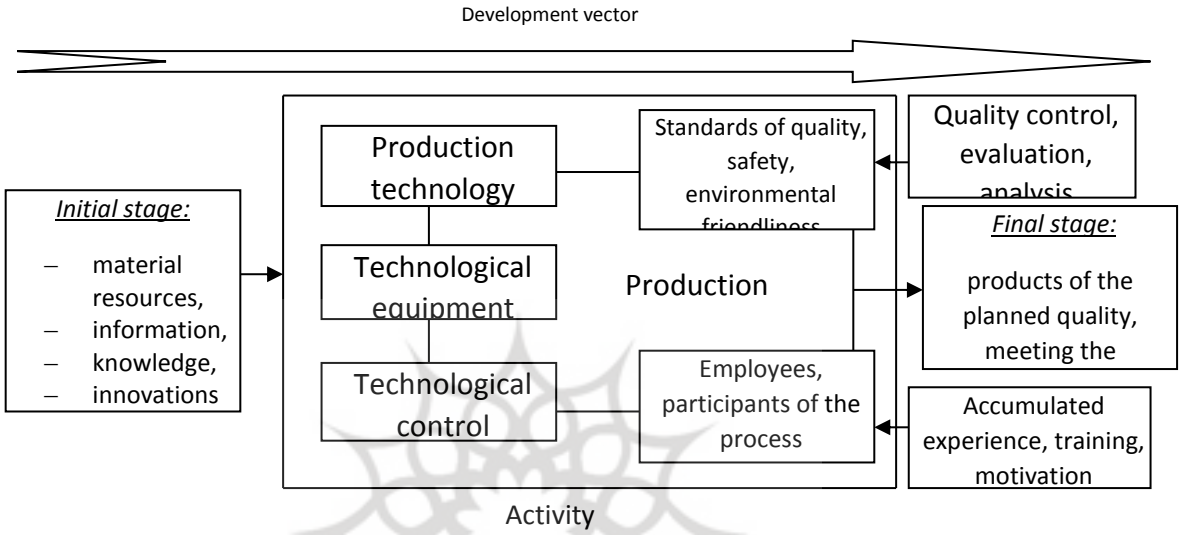


Fig. 2. Generalized model of integrated production process (Maksimova, 2014; Voynarenko, Yemchuk, 2016; Ivanova, 2016)

From this set of processes, the sequence of system development processes is formed

$$\{p_1 \to p_2 \to p_3 \to \dots \to p_N\} \tag{3}$$

Each individual process p_j can occur under the influence of the interaction of many systems (Fig. 1). Ensuring the process implementation is determined by such factors as material resources, information, knowledge, technology, experience and skills of employees, etc. (Fig. 2).

Thus, the vector of strategic development of the adapted quality management system VR, takes into account the value of real tangible and intangible assets of the enterprise, its potential. It also characterizes both the achieved and possible target states of the adaptive enterprise system, taking into account existing factors and development opportunities. It is these interrelated characteristics that allow to say that the vector of development of an adaptive product quality management system determines the target state of some aspect of the activity in the form of description of the state SD_l:

$$VR \rightarrow \begin{cases} VR_1 & \rightarrow \{p_{11} \rightarrow p_{12} \rightarrow p_{13} \rightarrow \ldots \rightarrow p_{1N}\} & \rightarrow SD_1 \\ VR_2 & \rightarrow \{p_{21} \rightarrow p_{22} \rightarrow p_{23} \rightarrow \ldots \rightarrow p_{2N}\} & \rightarrow SD_2 \\ VR_3 & \rightarrow \{p_{31} \rightarrow p_{32} \rightarrow p_{33} \rightarrow \ldots \rightarrow p_{3N}\} & \rightarrow SD_3 \\ \ldots & \ldots & \ldots \\ VR_L & \rightarrow \{p_{L1} \rightarrow p_{L2} \rightarrow p_{L3} \rightarrow \ldots \rightarrow p_{LN}\} & \rightarrow SD_L \end{cases} \quad (4)$$

Accordingly, the target state of development of the adaptive quality management system of the enterprisewill be determined by the ratio

$$SD = \bigcup_{l=1}^{L} SD_l \quad (5)$$

Moreover, the processes of different systems and different development directions can be interconnected:

$$\{p_{11} \rightarrow p_{12} \rightarrow p_{13} \rightarrow \ldots \rightarrow p_{1N}\}$$
$$\{p_{21} \rightarrow p_{22} \rightarrow p_{23} \rightarrow \ldots \rightarrow p_{2N}\} \quad (6)$$

Their interrelations and integration changes are system-forming fundamental factors in business processes formation, as each technological or economic process involves the implementation of a certain type of activity that can be used as a basis for its division into business processes.

An important condition for the proper organization of the quality management system is the definition of process indicators. To determine the indicators for each process, it is necessary to identify its long-term goals from the standpoint of the product quality management system strategy. We believe that achieving the goals of all processes in total ensures the achievement of strategic goals of the quality management system and corporate goals.

Therefore, with the help of indicators it is possible to meet the condition of measuring the degree of goals achievement (Fig. 3).

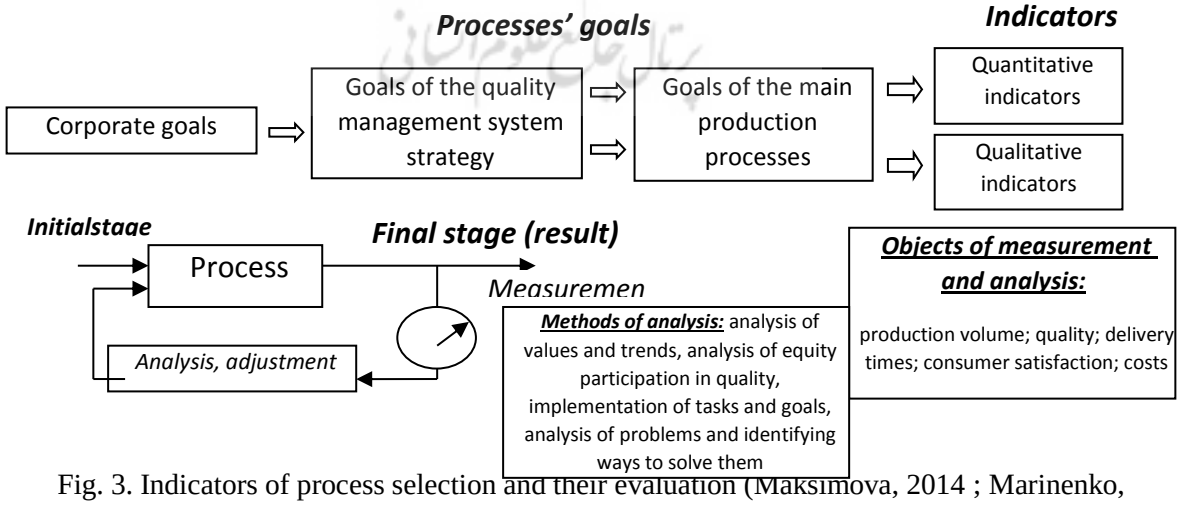


Fig. 3. Indicators of process selection and their evaluation (Maksimova, 2014 ; Marinenko, 2016 ; Hoop, 2016 ; Andersen, 2006 ; Zlobina, 2012)

The values of quantitative criteria characterize the quantity and quality of different types of resources needed to implement this process. In addition, they provide an opportunity to quantify the effect of the process from the standpoint of social utility, as well as saving certain types of resources. Among them are material resources (raw materials, technical and technological equipment necessary for the successful implementation of this process, materials, spare parts, etc.); energy resources (energy costs for the process or technology implementation); human resources (number of employees and the level of staff training required to implement the process); time worked (the amount of time required to implement the process with this technology of its organization); information resources (composition of data and knowledge, information and computer technologies necessary for the successful process implementation) (Voynarenko et al., 2019 ; Vitlinskiy and Riziki. 2012 ; Vovk et al., 2011).

In this case, all systems, processes, business processes and their relationships are subject to analysis from the standpoint of the product quality management system requirements. It is clear that in this situation there should be a feedback: in order for the business process to meet the requirements of product quality management system and general management system, it must be clearly defined by a consistent scheme analysed by all interested services. Among them are technological, planning and economic, production services etc. This will guarantee absence of unreasonable actions or complications in the final structure of business processes that form the processes of quality management. Based on the analysis of the obtained results, the process structure is formed, meeting the requirements of the quality management system.

In our opinion, the application of system and process approaches and building a set of business processes is necessary when using modern management information technologies and the latest, innovative approaches in all areas of social and production systems that can ensure a high level of product quality. This will optimize current management decisions within the industrial enterprise and form a single information space of its activities. From the above it should be concluded that achieving the target state Sj involves the implementation of development processes aimed both at developing the relationship of all types of business processes (Fig. 3) and system-wide development S0 (Fig. 1) (Voynarenko et al., 2017 ; Vitlinskiy and Riziki, 2012 ; Vovk et al., 2011). Then the total set of development vectors is determined by a system of vectors according to development directions:

$$VR = \bigcap_{i=1}^{K} = \bigcap_{l=1}^{L} \bigcup_{j=1}^{N} \left(p_{lj}\right) \tag{7}$$

It should be concluded that expression 1 defines the model of the strategic development vector of the adaptive product quality management system as a set of elements (systems, processes, and business processes) and integrated relationships between them, as well as their further development thus meeting systemic strategic goals. To assess the state and direction of

development, an efficiency criterion can be selected consisting of partial efficiency criteria, for each direction of development of the adaptive product quality management system Ek:

$$VR = \left\{ p_{lj}, P, E^k \right\} \tag{8}$$

The generalized model for the choice of the development direction vector for the multi-criteria elements of the product quality management system development strategy can be as follows:

$$VR_{\max} = opt\left\{VR_l\right\} = opt\left\{VR_1, VR_2, VR_3, \ldots, VR_L\right\}_{E^k} \tag{9}$$

Modern production systems of industrial enterprises are characterized by a variety of subsystems, complex relationships between them, a wide range of products, and special high requirements for the production staff qualification. Despite the multifaceted requirements for an adaptive product quality management system, it must clearly respond to changing market needs for manufactured products. In this regard, the approach of a continuous system of education and training in the field of quality is relevant. It is necessary to improve the skills of specialists in organizing and ensuring the production of quality products, to train employees in the basics of management, to promote the creation of special literature, magazines and other publications on this topic. It is also advisable to implement a set of measures to significantly improve the quality of human resources, which provides promising development of production and improving product quality.

To assist the staff in implementing quality systems and to increase the effectiveness of these systems, it is necessary to develop a system of internal qualified consultation processes, exchange of experience and initiatives.

An important component of the quality management system and the implementation of product quality management policy is the information effect. This is due to the fact that the quality of domestic products must ensure the solution of problems related to the transfer of information, its receiving and processing. Also, it I connected with the development of modern information technologies and the domestic industry of informatization. To this end, it is necessary to ensure the quality of information, all kinds of communications and computer equipment that meets high standards that can be applied in international practice. When implementing information security as a component of quality management policy in terms of development of information infrastructure and information services, it is necessary to ensure meeting several requirements. Such as: formation of databases on legislative and regulatory requirements for quality and safety of products and services in the country and abroad; free and maximum simplified access to these databases for domestic enterprises and manufacturers; development of modern information technologies, including technologies of continuous information support of the product life cycle, which provide the possibility of using computer methods of advertising, messages, ordering, advanced electronic methods of

registration and transmission of documentation, formation and transmission of information resources, etc.

It is clear that with the development of civilization, the amount of information, knowledge and skills that generations accumulate grows. To master them you need to increase efficiency in the use of various methods and tools, including information systems (artificial intelligence, neural networks, decision support systems) and, consequently, reduce the time to acquire knowledge and their use in quality management. Each subsequent stage of management requires the processing of information, new knowledge and experience gained in the past, ie requires the acquisition of both individual knowledge and processing of significant amounts of information and experience in their use. Accordingly, information support plays an important role in the implementation of the functions of the product quality management system (Voynarenko et al., 2018 ; Chernyshov, 2008). Using the methods of qualimetry, the process of implementation of any management function within the product quality management system in the information aspect, in conjunction with knowledge and communications, can be written down (Vovk rt al., 2011; Chernyshov, 2008 ; Schötza et al., 2017):

$$S_{koi(t)} \rightarrow i_{n(t)} + z_{n(t)} + k_{n(t)} \rightarrow NM \rightarrow i_{np} + z_{np} + k_{np} \rightarrow i_{yk} + z_{yk} + k_{yk} \rightarrow S_{koi(t+1)} \quad (10)$$

where $S_{koi(t)}$ is the state of the managed i-th object (parameter) in time t; $i_{n(t)}$ is information that reflects the state of the managed i-th object in time t; $z_{n(t)}$ is knowledge used by the managed i-th object in time t; $k_{n(t)}$ are communications used in the state of the managed i-th object in time t; NM are neural networks that provide the implementation of the management function for the i-th object based on information $i_{n(t)}$, knowledge $z_{n(t)}$ and communications $k_{n(t)}$; i_{np}, z_{np}, k_{np} are information, knowledge, and communication (respectively) generated by the use of neural networks, analysis and evaluation of results for management purposes; i_{yk}, z_{yk} are information and knowledge that have a managerial impact on the i-th object; k_{yk} are communications used to make managerial influence (managerial influence over time t), $S_{koi(t+1)}$ - state of the managed i-th object (parameter) in timet+1, after the implementation of managed influence.

This calculation determines the nature, structure and organization sequence of all systems involved in the formation of quality. Accordingly, within the product quality management system there can be identified processes, tasks, product types, knowledge, experience, communications, etc., which act as information objects. They are characterized by the amount of information resources, knowledge and communications used. Such resources may or may not be measurable. A qualimetric approach can also be used to quantify information resources (information saturation) and determine their sufficiency in relation to knowledge and

experience (only the measured indicators of the latter are taken into account). To implement the proposed approach, the information saturation of the k-th object by m - measured and n - unmeasured indicators of information saturation is written as:

$$INO_k = INO_b + \sum_{i=1}^{m} \Delta INO_i + \sum_{j=1}^{n} \Delta INO_j + \sum_{l=1}^{p} \Delta PZO_l + \sum_{s=1}^{t} \Delta NDO_s$$

(11)

where INO_k is information saturation of the k-th object; INO_b is the information saturation value of the basic information object; m is the number of measured indicators of information saturation; ΔINO_i is increase in information saturation caused by the i-th measured indicator of information saturation; n is the number of unmeasured indicators of information saturation; ΔINO_j is increase in information saturation caused by the j-th immeasurable indicator of information saturation; p is the number of measured indicators of basic knowledge; ΔPZO_l is increase in accumulated knowledge caused by the l-th measured indicator of basic knowledge; t is the number of measured indicators of basic experience; ΔNDO_s is the increase in accumulated experience caused by the s-th measured indicator of basic experience.

Practical aspects of computer technologies application in the quality management

Practical aspects of the computer technology using in the management system of industrial enterprises are based on theoretical research and expert evaluation of the results of enterprises obtained from the latest management systems using computer technology implementation. The advantages of using such systems are the ability to form high-quality information support, which is determined in the context of integrated information interaction with the components of the above elements of different systems of the overall management system. Accordingly, all components in the management system have their own information saturation, which is characterized by the volume, methods of obtaining information, information relationships in the use of the object and other factors that take into account the features of the quality management system. The sequence of formation of information support of production management systems of the researched enterprises of Khmelnitsky region with the use of modern computer technologies reflects the scheme (Fig. 4).

From here it is necessary to make a conclusion about approaches confirmation of the scientists concerning integral character of production quality and formation of an information paradigm of quality management system (Jiong, 2015). This indicates the inseparability of the information resource from the production of high-quality products and the effectiveness of the quality management system. The functioning and development of the product quality management system is ensured by highly qualified personnel through knowledge, proof and information. For this system to work organically and quickly, to respond to market needs, it is

necessary to constantly adapt the structure to the requirements of the environment and internal conditions. Therefore, there is a need to constantly search for modern methods of information processing, increase knowledge and experience, their evaluation, effective use and construction of communications for effective interaction.

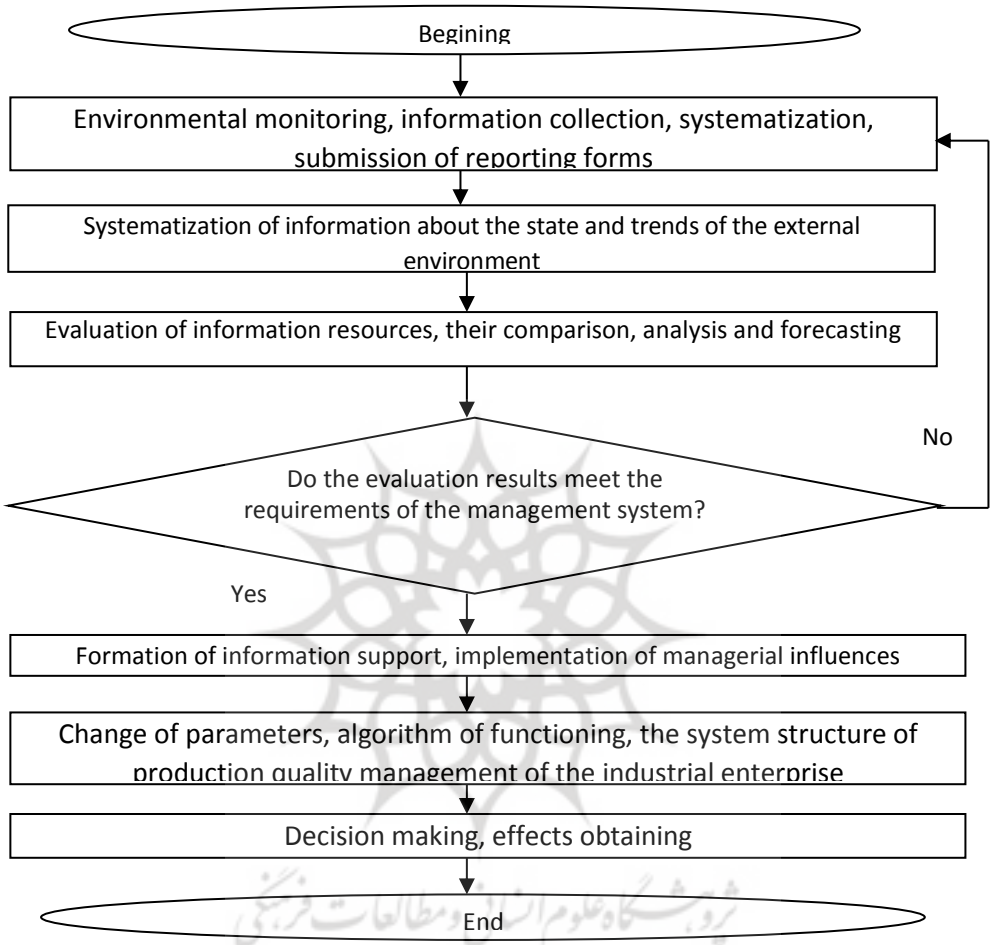


Fig. 4. Scheme of algorithmic approach to the formation of information support of product quality management system

The formation of an adaptive product quality management system determines the content of the process of adaptive strategic planning, which is an integrated system of methods and tools for flexible adaptation to the external environment and internal capabilities of the object of strategic management mechanisms, which form the methodological basis directions of strategic development on the way to achieve the target state and market position.

Since the external environment is extremely dynamic and unpredictable, the main tools for adapting the product quality management system are the following (Table 1).

The use of adaptive integrated product quality management systems for the studied enterprises of Khmelnytsky region provides the following advantages: increasing the manufacturability of development, implementation and operation of quality systems; creation

of a single harmonized organizational structure; reduction of costs for development, operation and certification in comparison with autonomous systems (quality, ecology, safety, etc.); the possibility of combining individual processes within integrated product quality systems; increasing mobility and ability to adapt to ever-changing conditions; ensuring greater coherence of actions within the enterprise; achieving a higher degree of staff involvement in improving the organization; the ability to take into account the balance of interests of external parties more effectively than in the presence of parallel systems.

Table 1. Tools for adapting product quality management systems

Name of tools	Meaningful content of the essence of the tools
Creating a flexible structure of the quality management system, based on system and process approaches	The structure of the system, built on such approaches, not related to norms, traditions and other constraints, allows you to respond most quickly to the slightest changes in the environment. It also provides an opportunity for a minimum period of time to reorient, change the direction of development and coordinate the development of other parameters.
Implementation of strategic planning	With this tool, the company can assess trends in the internal and external environment, define a quality management strategy and develop a quality management policy.
Creating a modern information system	This will reduce the uncertainty at the entrance and exit of business processes, timely receive reliable information for their management, and, as a consequence, maximize the degree of protection against making unreasonable management decisions.
Development of quality management policy	Planning measures to ensure the effectiveness of the product quality management system.

Results

Quality as a multifaceted category covers all types of enterprise activities - traditional and innovative, formed within each process, except by accident. It should be concluded that the responsibility for product quality is shared between all departments and participants involved in such processes.

The above factors require the fulfillment of the prerequisite for the formation and continuous expansion of knowledge in the field of quality, which is necessary to clearly define quality goals in the context of enterprise strategy and continuous quality improvement as a requirement for its sustainable development.

Today, continuous quality improvement is a powerful factor in scientific and technological progress, which is closely correlated with it.

The main reasons that motivate the constant search for ways to continuously improve quality are: globalization of markets and services; integration of socio-economic processes; exacerbation of environmental problems; increasing of personal, organizational-production and social needs; development of information transfer methods, information exchange and improving the quality of information support; the level of business management organization based on intellectual capital; consumer rejection of products and services with a low level of quality; growth of the role and pace of scientific and technological progress in the development of science, technology, all sectors of the economy and the world economy;

strengthening the requirements for intensification of production and increase its efficiency as a necessary factor for successful development of enterprises; formation of the world economic society on the basis of harmonious development of society, personality, global balance of production, preservation of the environment on a planetary scale.

Conclusion

Based on the results of our research, we have developed scientific and methodological approaches to increase the efficiency of the quality management system of the enterprise using the latest computer technology.

The relevance of the researched problems is confirmed by the fact that at the present stage of development of science and technology, the world economy is gaining a dominant position in the formation of a heterogeneous environment, with quality information, rapid development of the world economy and their implementation in management systems of the companies of different industries. Such conditions radically change the conditions of functioning of the product quality management system, which requires the search for new scientific and methodological approaches in the study of the management system, which are based on the use of economic and mathematical methods and models and computer technologies. This will provide the company's management with reliable tools for effective organization of the management process and sound management decisions to achieve a high level of product quality.

The study determined that the development of an adaptive product quality management system is a transition to a new stage of interconnections of interdependent elements (systems, processes, business processes) that arise under the influence of interaction with other systems, such as: general management systems, production, regulatory, intellectual, innovative, communication, information and computer. The integration of links between systems is through the integration of goals, resources, functions, processes and other components that are subject to a well-founded goal, and thus ensure the implementation of adaptive mechanisms of the product quality management system.

The conclusions obtained as a result of the study of practical aspects in the chosen direction, confirm the hypotheses about the cost-effectiveness of computer technology: the transition of capital costs to operating; reduction of operating costs; increasing the quality of information support of the product quality management system.

The proposed approach allowed to determine both the direction of systems development and the target state of the adaptive integrated product quality management system. The value of the proposed scientific and methodological approaches is that without making changes they can be used in enterprises with different forms of ownership, in different sectors of the economy.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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