The role of quality management systems for educational institutions in the digital economy

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Abstract. One of the priority tasks of education in the modern conditions of economic management is to provide quality technological and personnel reserves for the implementation of the tasks set by the Government of the Russian Federation in the field of development of the digital economy of the country. Considering the approaches to the transformation of all types of activities into a digital platform, it is possible to note the stage-by-stage transformation of the information infrastructure over the last period of development of market relations in the direction of digital transfer of information, knowledge and technologies. One of the barriers preventing a faster transition to new challenges to reality is the lack of compliance of the level of personnel training with the requirements of QMS standards, in particular the requirements of ISO 21001-2018 and ISO 9001-2015. The article considers the peculiarities of the requirements of the regulatory framework for the organization of QMS of higher education institutions, presented in the form of tasks described in the roadmap. The novelty of the proposed approaches consists in the integration of QMS requirements in the construction of a competency model. The proposed solutions to improve the processes of personnel training will ensure that society can implement the Passport "National Program "Digital Economy of the Russian Federation".

1. Introduction. Basic concepts of digitalization and digital economy

The digital economy is understood as a system of socio-economic relations based on the use of digital means of communication and new information technologies [1].

The conceptual approach to the use of digital resources to improve the efficiency of organizations is interpreted in many documents as "digitalization", and this concept is nowadays used in a particularly wide way. For example, the Strategy for the Development of the Information Society in the country focuses on the mass introduction of domestic production tools in the field of digital interaction of complex systems, in particular, integrated production structures [2-4]. Higher education institutions are expected to train personnel that meet the requirements of the digital economy [5-7].

Many authors [10-14] consider digitalization as a process of transformation and presentation of various data in electronic form. Over the past three years, the regulatory framework has been significantly supplemented by new guiding documents, the essence of which reveals the opportunities for the development of individual areas of the digital economy and the country's economy as a whole, as well as its informatization.

Analysis of the essence of the content and requirements of the roadmap discussed in the Passport "National Program "Digital Economy of the Russian Federation " (hereinafter referred to as the CERF Passport) [8], and the Programs of Socio-economic Development of the country for the period up to 2030 [9] showed that they focus on the emergence of new concepts and definitions, new standards of digital data processing and tools for their practical implementation.
Standardization is also understood as the process of application of regulatory requirements and rules ensuring the quality of collection, processing, transmission and storage of information by the personnel, which allows to regulate the existing information flows and manage their application in all spheres of activity, for the purpose of making quality management decisions, and taking into account modern approaches of informatization and digitalization. Therefore, one of the key tasks in higher education is the formation of a set of new competencies that meet the requirements of the FSES, which should ensure the implementation of the requirements of the CERF Passport and the existing professional standards of the application to a particular subject area, for example, in the field of management. The analysis of the requirements reflected in the CERF Passport for technological and human resources management has shown that there are pressing problems that hinder the development of digitalization in educational institutions (Fig. 1)

![Diagram](image)

**Figure 1.** Analysis of the problems hindering the formation of the technological backlog of digitalization processes

From figure it is visible that one of the main problems for realization of directions of routing is a lack of experts who can operate processes of acceptance of administrative decisions on workplaces of users as do not have the special skills and the skills corresponding to requirements of time. It is necessary to be ahead of the mass demand, to bring to the market specialists who already have the required set of competencies.

Of course, the objective reality is a significant advance in the development of information technologies, computerization and communication tools before learning tools, and this is one of the problems of higher education. Another problem is the lack of time for retraining and professional development of teaching staff, who carry out the transfer of knowledge to students. Without going into revealing the peculiarities of the removal of these conflict situations, we will focus on the process of personnel training itself. The article investigated the problems of organizing the process of training managers and their correlation with the identified needs of the country, identified within the framework of the problem of paragraph 2.1 of the «Road Map».

A fragment of the Roadmap [1, pp. 38-39] with the planned terms of its implementation and the key indicators being formed is shown in Table 1. Thus, for example, the concept of "Internet of Things" (IoT) has been used recently, the mastering and implementation of which in the practical management of real production contributes to the transition to a new stage of development of the Internet, as it allows to significantly expand the opportunities for the collection, processing and distribution of data, including the processing of knowledge [15].
Table 1. Roadmap fragment of the CERF Passport.

| 1. Ensuring the training of highly qualified personnel for the digital economy |
| --- |
| 1.1 The concept of the basic model of digital economy competences, the list of key competences and the mechanism of their updating were developed | 01.10.2019 | Ilya Torosov, Deputy Minister of Economic Development of the Russian Federation |
| 1.2 A venture fund was created to support promising educational technologies of the digital economy | 30.12.2019 | Ilya Torosov, Deputy Minister of Economic Development of the Russian Federation |
| 1.3 Approves the open format of competence profiles of citizens, their development trajectories and procedures for their creation | 30.06.2020 | Alexey Sokolov, Deputy Minister of Digital Development, Communications and Mass Media of the Russian Federation |

Table 2 shows a fragment of the Roadmap [1, p.72-73], which allows the educational institution to restructure its educational activities taking into account the qualitative components of project activities.

Table 2. Roadmap fragment of the CERF Passport.

| 1. Introduction of digital technologies and platform solutions in public administration and public service delivery, including for the benefit of the population and small and medium enterprises, including individual entrepreneurs |
| --- |
| 1.1 Legislation has been drafted to ensure that government agencies primarily use a single e-government infrastructure | 31.12.2019 | Oleg Pak, State Secretary - Deputy Minister of Digital Development, Communications and Mass Media of the Russian Federation |
| 1.2 The federal law and other normative legal acts fixing the target state of provision of state and municipal services have been developed and adopted | 31.12.2020 | Savva Shipov, Deputy Minister of Economic Development of the Russian Federation |

It will allow to form competences regulating sphere of production of a full cycle of production and use of the technical decisions providing information interaction by means of machine and cognitive interfaces, including the Internet of things. In these economic conditions, one of the priority tasks of higher education institutions is the quality training of personnel, which is ensured through the introduction of quality management system in the educational institution. This stimulates the staff of higher education institutions to constantly improve all internal processes and thus allows achieving positive economic effects.

2. The role of quality training in the digitalization environment

Considering the quality of education, we mean the quality of the result of the educational process, that is, the set of characteristics that determine the ability to sufficiently meet the needs and expectations of external consumers of educational services. In other words, the quality of this or that characteristic of education is such a level that is in demand and meets the requirements of the consumer. In our opinion, the diversity of definitions of the concept of “quality” is caused by the impossibility to express in a single definition absolutely such equal characteristics of this concept as absolute and relative (comparative) quality.

Absolute quality is a philosophical category characterized by a set of individual properties of an object. The most capacious is the definition of quality as compliance with the norm, standard. Unity of needs in the properties of the object (compliance with the norm, standard) makes it possible to compare the real properties of different objects with each other. The use of the concept and features of relative quality makes it possible to compare the objects from the economic point of view. Specificity of educational service is the presence of dualism in the concept of quality. On the one hand, as a provider of educational institution offers the applicant an educational program in conjunction with other (personnel, scientific and technical, etc.) components of its potential, and on the other hand, a
specialist who has received a professional education, entering the labor market, faces the assessment of the quality of his professionalism by the employer. Accordingly, there are significant differences in the quality of educational services, including the methods of their qualification and benchmarking assessments. An important component of the marketing strategy of the university is adequate positioning of the services provided by it according to the price characteristic, namely: accessible education, elite, balanced combination of quality and price. It is necessary to bear in mind that the consumer of educational services will pay a higher price for them if the university can visually present to him additional competitive advantages of its educational programs, provided services (for example, quality of service), qualitatively distinguishing them from the programs or services of competitors. In view of the above, we can propose the following definition of the content of educational services. Educational service is a set of ordered information transmitted to the learner in the form of knowledge of educational, special and specialized nature, as well as some of the most important practical skills of their use in the chosen learning industry or specialty, the formation of positive personal characteristics necessary in professional activities [16]. The concept of “quality of education”, which includes not only cognitive, social and cultural characteristics, is an integral characteristic of educational activity as a process and its outcomes. The modern approach is characterized by a sharp increase in the requirements for quality assurance in higher education. In order to ensure the solution of this problem it is necessary to solve the issues with the modernization of the quality assurance system, for this purpose it is necessary to develop indicators, evaluation criteria, methodologies, as well as to solve the issues on the development of effective mechanisms to ensure rapid assessment, the possibility of eliminating the detected negative phenomena, the formation of measures to ensure the growth of quality indicators of the educational institution. Quality management systems (QMS) are one such mechanism. 3. Quality management systems of educational institutions In accordance with the terminology of ISO International Standards (IS) "Quality management system is a management system for the management and administration of an organization in relation to quality" [16]. The first international standards ISO 9000 series were developed and approved in 1987. In 1994 and 2000 the work on revision of ISO 9000 series was carried out taking into account the accumulated experience on their application and forecast of the world tendencies of quality problems development. In 2008, the international standard ISO 9001:2008 (ISO 9001-2008) was published. The latest version is the standard of quality management system ISO 9001:2015 (ISO 9001-2015) [17]. Modern trends in the field of quality assurance of education and the basic models of quality management in the university today continue to be considered on the basis of the model of quality management system that meets the requirements of the international standard ISO series 21001: 2018, the requirements of ISO series 9001:2015, the model of the European Foundation for Quality Management (EFQM), as well as various models of national and regional quality awards and their modifications for higher education. Below is the structure of ISO 21001:2018 standard "Educational organizations - management systems for educational organizations - requirements with guidance for use" ("Educational organizations - Management systems for educational organizations - Requirements and guidelines for use"). Let's consider some of its features. 3.1. ISO 21001-2018 requirements for the activities of educational institutions The standard applies to higher, secondary, secondary, specialized and primary educational institutions, as well as institutions providing additional education services. ISO 21001 provides users with a model that is designed to be as convenient and effective as possible for a variety of educational institutions. Confirmation of the implementation of ISO 21001 standard and obtaining the certificate will allow the educational organization to demonstrate to all stakeholders a high level of quality of educational services, as well as to obtain additional points related to the existence of a quality system. It is important to note that the standard can be used by educational organizations not only to ensure the quality of educational processes, but also to organize research activities.
Figure 2 provides a brief description of the organizational structure of the standard.

![Organizational structure diagram](image)

**Figure 2.** Organizational structure of the standard.

This standard is based on the following principles of education management:

a) The orientation of students and other beneficiaries;
b) Visionary leadership;
c) Involving people;
d) Process approach;
e) Improvement;
f) Informed decisions;
g) Relationship management;
h) Social responsibility;
i) Accessibility and equity;
j) Ethical behaviour in education;
k) Data security and protection

As an example, we will further look at the process approach (d) and evaluate the quality of the educational process. The emphasis will be on the fact that the actual completeness of the process can be assessed on the basis of a qualimetric approach.

3.2. **ISO 9001-2015 requirements for the activity of educational processes**

The version of the ISO 9001-2015 standard was developed in accordance with the annex to the ISO Annex SL (ISO/IEC Directives, Part 1 Consolidated ISO Supplement - Procedures specific to ISO) directive. The directive defines the requirements for regulatory documents for management systems. It establishes a new, uniform standard for the structure of management systems (not only ISO 9001, but also for other management systems).

According to this directive, all management system standards will be brought to a single structure and will have common section names.

The management model, based on the requirements of the international quality standards ISO 9001:2015, assumes compliance with the following quality management principles:
a) Consumer orientation;
b) Leadership by management;
c) People-to-people interaction;
d) Process approach;
e) System approach to management;
f) Continuous improvement of activities;
g) Evidence-based decision-making;
h) Relationship management.

One of the basic differences of GOST R ISO 9001-2015, in our opinion, is reflected in the requirement to measure the control points of the beginning and end of the processes of quality management systems [18].

As an example, we will further consider the process approach (d) and evaluate the quality of the educational process. The emphasis will be on the fact that the actual completion of the process can be estimated on the basis of the qualimetric approach.

4. Our achievements in quality management for the digital economy

4.1. Algorithm of educational process management on the basis of integration of standards GOST R ISO 9001-2015 and GOST R ISO 2001-2018

When managing business processes, based on the principles of TQM, we will focus on one of them "making decisions based on facts". It has a direct link with the requirements of GOST R ISO 9001-2015, as the measurement of key process indicators, namely the points of its beginning and end, in our view, ensures the implementation of this principle.

This is the first advantage acquired by the organization during the implementation of the standard.

The second basic advantage is that risks of process activity essentially decrease if the control and measurement of key points of process will be realized at system level.

Therefore, introducing in the activity requirements of GOST R ISO 9001-2015, top-management of the organization should put before the employees following problems. Their decision is presented by stage-by-stage algorithm of realization:

Stage 1: Identify and justify the main educational processes that are necessary for the quality management system of the organization and its development;

Stage 2: Identify the key start and end indicators in each of the processes ("required inputs and expected outputs") and describe their quantitative parameters, accepting these values as normative;

Stage 3: Determine the interrelated hierarchy of processes, justifying their sequence and conditions of interlevel interaction (transitions);

Stage 4: Determine the allowable risk zone for making a wrong decision about the possibility of transition from one process to another.

Stage 5: Modeling of educational processes based on the requirements of GOST R ISO 2001-2018.

Stage 6: Critical assessment of the “Entry” and “Exit” points of the process based on the requirements of GOST R ISO 9001-2015.

Stage 7: Risk assessment of non-achievement of goals on the basis of the risk management tool defined in the standard GOST R ISO 9001-2015 and the formation of corrective effects on the process.

It is impossible to solve the set tasks if the employees of the organization do not have the tools of standardization and skills of their practical implementation in the management of the quality of business processes, their monitoring and evaluation of the effectiveness of management decisions.

4.2. Example of implementation of author's approaches in the educational process

The Digital Economy of the Russian Federation Passport pays special attention to the formation of the personnel component and the intellectualization of knowledge.

"Knowledge" is a resource based on the practical experience of specialists and on information that allows to form new knowledge. The ability to acquire, integrate, accumulate and apply knowledge increases its competitiveness. Therefore, intellectual activity is considered as the main one in all regulatory documents of the Government of the Russian Federation related to the socio-economic
development of the country [19]. As we can see from the roadmap (Table 1,2), the first requirement is to develop a model of competencies that could provide the labor market with demanded specialists. To solve this problem, the Institute of Finance, Economics and Management studied the requirements of labor standards and labor functions, which could be correlated with the challenges of the CEFF Passport. The most difficult, in our opinion, is the implementation of paragraph 2.1, which reflects the requirements for the development of tools for the certification of emerging competencies in the education system and the digitalization program. Let's assume that we need to carry out qualitative training of a manager to work in a full production cycle. According to the challenges of the Roadmap, knowledge of the Industrial Internet of Things (IIoT) is required. As an example, let us consider the requirements of FSES 3+ for the preparation of bachelors in the direction of "manager". Table 3 shows the purpose of educational activities, which should be subsequently certified by evaluation funds.

**Table 3.** Baseline data for assessing the probability of achieving the objective.

| Goal | Subobjectives | Tasks |
|------|---------------|-------|
| Introduction of IIoT in the educational process of preparation | 1. Formation of knowledge in the field of production automation | 1.1 Study of peculiarities of production automation<br>1.2 Development of automated production management skills |
| | 2. Formation of knowledge in the field of "big data" processing | 2.1 Study of modern computer technologies for "big data" processing<br>2.2 Building "big data" management skills using modern computer tools |
| | 3. Formation of knowledge about the processes of intermachine communication | 3.1 Formation of knowledge base about the processes of intermachine communication<br>3.2 Building skills to manage intermachine communication processes |

Let's introduce signs: let's say it's the probability of achieving the main goal. Let's set it at 95%. It has been determined by experts that in order to achieve the main objective (1) it is necessary to ensure the achievement of three subobjectives (1.1, 1.2, 1.3) in terms of the required performance (EGP) of functioning. Then, Table 4 will define quantitative requirements for the indicators of the completion of controlled processes to ensure the required level of quality of solution of the target task.

**Table 4.** Formation of normative indicators to ensure target parameters.

| Target | Probability of collateral, % | Subtargets | Probability of collateral, % | Tasks | Probability of collateral, % |
|--------|----------------------------|------------|----------------------------|-------|----------------------------|
| Implementation of IIoT in the training process | 95 | 1. Formation of knowledge in the field of production automation | 98,3 | 1.1 Study of peculiarities of production automation<br>1.2 Development of automated production management skills | 99,15 |
| | | 2. Formation of knowledge in the field of "big data" processing | 98,3 | 2.1 Study of modern computer technologies for "big data" processing<br>2.2 Development of "big data" management skills based on modern computer tools | 99,15 |
| | | 3. Formation of knowledge about the processes of intermachine communication | 98,3 | 3.1 Formation of knowledge base about the processes of intermachine communication<br>3.2 Development of interpersonal communication management skills | 99,15 |
Formed competences can be recommended to be studied in the process of building their own model of knowledge in the discipline under study and use of production rules for their extraction on the simplest examples.

5. Conclusion
The digital economy is represented by the following 3 levels, which in their close interaction affect the lives of citizens and society as a whole, this:

- markets and sectors of the economy (spheres of activity), where interaction of specific subjects (suppliers and consumers of goods, works and services) is carried out;
- Platforms and technologies where competencies for the development of markets and sectors of the economy (spheres of activity) are formed;
- Environment, which creates conditions for the development of platforms and technologies and effective interaction of subjects of markets and sectors of economy (spheres of activity) and covers normative regulation, information infrastructure, personnel and information security.

Due to the fact that the effective development of markets and industries (spheres of activity) in the digital economy is possible only in the presence of developed platforms, technologies, institutional and infrastructural environments, it is advisable to consider two lower levels.

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