

The System of Monitoring Education Quality and Quality Assurance at the Higher Educational Establishment in Accordance with the Criteria and Standards of the Russian Association for Engineering Education

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Abstract

Background/Objectives: The aim of the study is to identify meaningful evaluation and approaches to building a model of the system of monitoring education quality and quality assurance at the university. **Methods:** The research methodology is based on a pedagogical qualimetry approach revealing a nature and characteristics of education quality, principles and methods for education monitoring, domestic and international theoretical foundations of independent evaluation of higher education quality. **Findings:** The international context of the changes specified by networks of agents-intermediaries Accreditation Board for Engineering and Technology (ABET) in the Washington Accord – an “American” model, EUR-ACE Framework Standard – a “European model”, the International Energy Agency (IEA) International organization and European Network for Accreditation of Engineering Education (ENAE), the Asia-Pacific Economic Cooperation (APEC) Engineer register have determined the new content for improving the quality of higher education in the activities of the Trans-Baikal State University as a supporting institution in the region. The objectives and mechanisms for the implementation of international requirements of independent quality evaluation in the supporting institution in the region indicate the search for management solutions for the study and introduction of international experience considered as a base for creating a new educational practice of monitoring of education quality and quality assurance at the university in accordance with the criteria and standards of the Russian Association for Engineering Education. **Applications/Improvements:** The result of the study is the model of the system of monitoring of education quality and quality assurance at the university, built on the basis of theoretical research.

Keywords: Education Quality, Education Quality Assurance, Evaluation, Monitoring

1. Introduction

One of the important tasks of managing the scenario planning of prospects of university development as a supporting institution in the region, improving the quality of educational services and quality of higher education in general, is to create an education quality monitoring system. The tendency of growth of demand for quality

education sets tasks at different levels of university management to ensure education quality assurance for the real and potential needs of stakeholders to give the greatest return on invested means in education at the same time.

New priorities of society and challenges of modernity set the new parameters of functioning and development of education systems and set up new tasks. At the same time, the entire responsibility is placed on the educational

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institutions¹. The provision enacted in 2003 in Berlin by the communique of the conference of higher education ministers of 33 European countries remains relevant. It reads that the responsibility for the higher education quality assurance is primarily the responsibility of the educational institutions themselves. Moreover, the responsibility of higher educational institutions increases².

Currently specific requirements are imposed on the quality of higher engineering education as the basis of scientific and technical potential, progressive social dynamics and sustainable economic growth in the region and in the whole country. At the same time, international experience in evaluating the quality of education shows that in most cases its dissemination in the domestic practice encounters two obstacles – the lack of information about education quality and quality assurance and the lack of mechanisms to monitor the dynamics of their implementation.

This fact determines the need to establish education management at all levels of monitoring systems of education quality. It should be noted that the development and implementation of conceptual approaches and instruments for monitoring education quality are associated with a number of methodological and applied problems, without solving which, the monitoring is not able to perform its tasks³.

Step by step analysis of international and Russian approaches to evaluating the quality of higher education and training programs was carried out to determine the content of monitoring quality and quality assurance of training of engineers:

- Stage 1: Comparative analysis of international and Russian models of quality evaluation and quality assurance in higher education.
- Stage 2: Determining the subject of evaluation in the international agreements and models of education quality, regulating the mutual recognition of engineering qualifications and professional competence.
- Stage 3: analysis of the International CDIO Engineering Education Standards.

2. Concept Headings

The aim of the study is to identify meaningful evaluation and approaches to building a model of the system of monitoring education quality and quality assurance at the university.

3. Result

The designated realities actualized the need to resolve the basic contradiction: between the institutional and programmatic dissemination of international requirements of an independent education quality evaluation, ensuring this evaluation and the need to develop new educational practices of monitoring engineering education quality and quality assurance considering regional resources – monitoring objects in a multidisciplinary university as a supporting institution.

The identified contradiction and gaps that require permission have determined the research problem, which is to implement the search for an answer to the question of what are the trends and prerequisites, arrangements and conditions for the establishment of monitoring education quality and engineers training quality assurance, and recognition of engineering programs at multidisciplinary university as a supporting institution in the region.

The objective need to develop a coupling of scientific and educational potential of the university and regional practice has defined the aim of the work.

The aim of the research is to determine the organizational and pedagogical basis for creating the system of monitoring education engineers training quality and quality assurance.

Setting of such a goal has determined the objectives of the study:

1. The analysis of foreign and domestic traditions, models and experience in the field of quality evaluation and quality assurance of higher education.
2. The study of approaches for achieving the quality of higher technical education in the international practice.
3. Determination of constant and repetitive quantitative parameters of estimation in the International Conceive Design Implement Operate (CDIO) Engineering Education Standard.
4. Description of experience of management actions on creation of the system of monitoring education quality and quality assurance in Transbaikal State University.

The researchers propose the following sequence of processes: analysis (international context: American and European models) → setting (Russian practice: Russian Association for Engineering Education (RAEE)) → reorganization and a new practice (the university practice).

Present the results of step-by-step analysis of international and Russian approaches to the evaluation of the quality of higher education and training programs which was conducted to determine the content of monitoring the engineers training quality and quality assurance.

During the first phase (task 1), the analysis of foreign and international materials on evaluating the quality of higher education was performed taking into consideration the parameters which provided horizontal comparability of the main focus of monitoring techniques different by type. It is important to note that in order to achieve and maintain a high level of education, it is necessary to create and implement a monitoring system of its education quality.

During the analysis of the various methodologies, different meanings of the category of "evaluation" were identified, which describe the techniques of the monitoring system construction:

"Evaluation" is the term of quality assurance in a global sense, which involves several types of evaluation that are most common in international practice. The first one is evaluation in the context of "*organization quality management system*"⁴. The focus of this notional attitude is aimed at the potential benefits for the organization due to the quality management system implementation. Among these in accordance with the international standard are the following ones:

- The ability to consistently deliver products and to provide services that meet customer's requirements and applicable to legal and regulatory requirements as well;
- development of opportunities for improving customers' satisfaction;
- considering the risks and opportunities related to its context and objectives;
- the ability to demonstrate compliance with established requirements of quality management system.

This International Standard can be used by internal and external parties. Section 9 of the Standard "Performance-based Evaluation" includes requirements for monitoring, measurement, analysis and evaluation, internal audit and senior staff review. These basic and uniform requirements for any field of activity determine monitoring foundations in the education system as well. Constant compliance with these requirements, as well as accounting for future needs and expectations enables an organization to meet

the challenges of a rapidly growing and increasingly complex environment. To achieve this, the organization might find it necessary the use of various improvement methods such as breakthrough changes, innovation and reorganization, in addition to the correction and constant improvement. Significant changes, related to monitoring education quality and quality assurance, have taken place at the level of educational programs.

The second notional attitude – "evaluation of vocational education and training systems" – focuses on the basis of the Copenhagen decisions on development and testing of various models in the field of quality assurance of Vocational Education and Training (VET), evaluation and certification of qualifications and non-formal education, VET standards, competencies, etc. Sharing the experience of these developments and distinguishing general principles of VET reforming laid the foundation for the adoption of an integrated development strategy, determining the general framework, describing procedure that can be used by providers in the implementation of training⁵. The principles and procedures contained in the Common Quality Assurance Framework include a monitoring system for measurement and promotion in achieving the objectives. This system provides for the participation of both the students and the specially trained experts who will carry out a comparison of the success of different providers⁶.

The third attitude – "evaluation of vocational education and training policies based on evidences", according to the materials of the Torino Process, is implemented in order to reach agreement on the ways of further development of vocational education and training policies and systems. The special value of this approach lies in the fact that VET is considered in the context of socio-economic development, and the analysis is based on evidence and through a structured dialogue⁷. The Torino Process is aimed to introduce monitoring of long-term strategies (for example, road maps). The basis of evaluation is analytical frame, which is a tool for collecting and interpreting qualitative information, quantitative data contextualization.

Next notional attitude is objectified by The International Standard Classification of EDucation (ISCED), in which the evaluation is the collection and provision of statistical data. The ISCED 2011 is not designed to directly assess competencies of individual students that is due to the lack of a direct relationship between educational programs or qualifications and actual educational achievements. Despite of this, according to the provisions of the ISCED,

national and regional qualification systems can be useful monitoring tools for differentiation of knowledge, skills and competencies related to programs and qualifications.

The last attitude is due to the Methodology of the national system of Russian university rankings and involves the analysis of activities and stimulating the development of higher education institutions; analysis and ranking of five functions of higher education. According to this methodology, the quality of the following functions implemented by higher education institution is examined: scientific and research activity, learning and teaching, international activity, knowledge transfer and cooperation with the region as the most popular types of the university activity directions, allowing fairly quickly giving an idea about the university status. The emergence of university rankings and building of higher education quality monitoring system on its base determines the strategy of the university in the educational market: competitive not only in the domestic market, but also in the international one.

Monitoring higher education quality is only possible when the monitoring object is expressed in operational terms, related exactly to the quality of higher education, and not to anything else. These methodologies for evaluating the quality supplement and enrich the content of monitoring the higher education quality, and the selected units of analysis can be considered as directions for monitoring (Table 1).

At the second phase of the analysis (task 2) the approaches to achieve higher quality of engineering education are considered. The analysis of monitoring models for evaluating the quality of higher education has shown that there are two approaches in international practice.

An external approach is connected with the external evaluation of high school quality. It is mostly typical for countries with a strong influence of education state administration bodies. National State education administration body sets requirements, determines the criteria for evaluating the quality of higher education and provides a system of external quality evaluation and quality assurance in higher education. In the European system of higher education quality, this approach is referred to as "continental". As part of the external approach, the percentage of higher education institution graduates prepared for the further successful development of the economy is specified.

Turning to the consideration of another – internal (UK) – approach, we should highlight its fundamental

peculiarity: the state bodies intended for the evaluation of higher education do not play a significant role in the evaluation system. Self-evaluation here comes in the foreground that is aimed at improving the activities of the higher education institution. Independence and autonomy of the institution plays a special role. In this case, specifics of the institution, in accordance with which priority directions of development and accreditation indicators are lined up, is considered during self-evaluation. It should be noted that the prevalence of internal self-evaluation of higher education quality is typical for the United States and countries accepted an American sample of educational process quality evaluation in higher educational institutions (Philippines, Taiwan, and others)⁸.

As the US and European models for evaluating the education quality are competitive, we can select their key features and consider options of approaches to higher education in the US and Europe. Criteria of the American model of education quality evaluation, which were formed over a long period of time, consider particular economic and scientific potential of the country and differ from the criteria used in the European countries. It should be noted that the system of relations "university-state" in the United States has its own specific peculiarities that allows selecting three models of university relations in the system "university-state" in this country: 1. "the university, which enjoys the support of the state"; 2. "the university controlled by the state"; 3. "the university that is free from the state in the matter of decision-making"⁹.

At this stage, international agreements were also examined, which govern the mutual recognition of engineering qualifications and professional competence (*International Engineering Alliance*)¹⁰. Each of the member countries of the agreement shall satisfy the statutory requirements. Three agreements cover the mutual recognition in respect of qualifications of the third level in the field of mechanical engineering:

1. The Washington Accord¹⁰ signed in 1989, was the first one. ABET in the Washington Accord on the basis of procedure of substantial equivalence evaluation recognize qualifications in the field of vocational technology (four years). Today, ABET is a world leader in the development of new criteria, procedures and evaluating methods of educational programs quality. Criteria 2000, designed by ABET, are currently used by accrediting organizations in many countries as a basis for developing their own national systems of

Table 1. Comparative analysis of monitoring methodologies

No. in sequence	Document title	Monitoring methodology	Object, subject, unit of analysis	The main focus of documents under analysis
1	The international standard ISO 9001: 2015. Quality management systems. Requirements. For educational purposes	Measurement, evaluation and analysis of indicators as regards the organization functioning and effectiveness	Organization quality management system	Improving performance and creating a reliable basis for its sustainable development initiatives
2	Documents of the Copenhagen process	Measuring promotion towards achieving the objectives and the formal evaluation system, which allows drawing conclusions on the achievement of objectives; it provides a feedback system that ensures making the necessary adjustments on the monitoring results	Systems of vocational education and training	Development of cooperation in the area of quality assurance with a focus on the exchange of models and methods, as well as the development of common criteria and quality principles for VET
3	Documents of the Torino Process	Analytical framework, which is a “tool for collecting and interpreting qualitative information, quantitative data contextualization, as well as monitoring the implementation and progress of VET development, including the comparison with the national, regional and international indicators (if necessary)”	Analysis of vocational education and training policies on the basis of evidence	Data collection, advanced consulting, design reports and quality assurance/peer review, approval and distribution of the final country report, agreement on three key priorities/areas of further work
4	International Standard Classification of Education (ISCED)	Collection and provision of statistical data	National (sub-national) educational program	Classification and presentation of statistical data comparable on international level as regards national education systems
5	The methodology of the national Russian universities ranking system	Analysis of activity and stimulation of development of higher education institutions; analysis and ranking of five functions of educational institutions of higher education	Five functions of educational institutions of higher education: research activities, teaching and learning, international activities, knowledge transfer and cooperation with the region	Evaluation of higher education institutions by five selected functions of universities, development of a database on the status and development of higher education systems, development of a transparency tool and external quality evaluation of educational institutions of higher education, promoting the creation of informational and analytical basis for benchmarking (identifying the best practices) and for stimulating the demand for the higher education services in the country

accreditation criteria. While distinguishing strengths and weaknesses of the educational program under analysis, the following objectives were adopted as the key ones: confirmation of graduates' training quality, the importance of particular educational program, modernization of engineering education.

2. The Sydney Accord¹⁰ was launched in 2001 and recognizes the substantial equivalency of accreditation in engineering qualifications (three years).
3. The Dublin Accord¹⁰, which came into force in 2002, is an agreement on substantial equivalence in the accreditation of qualifications in engineering technology (two years).

The following three agreements cover the recognition of equivalence at the level of practicing engineer. The concept of these agreements is the mutual recognition of engineering competence in the participating countries of the agreement after receiving the registration.

The very first such agreement APEC Engineer agreement¹⁰ was introduced in 1999. The agreement basically acts between engineering bodies, but there may be government offices. Significant changes must be signed at the governmental level. International Professional Engineers agreement¹⁰ introduced in 2001. The agreement has the same requirements, but any country can be its member. International Engineering Technologist agreement was signed in 2003. Parties of the Agreement have agreed to proceed with the establishment of a mutual recognition scheme for engineering technologists¹⁰.

EUR-ACE Framework Standard is also attractive, the task of which is to "ensure the transnational recognition by distributing a single "European mark"; to promote the extension of mutual recognition agreements, to ensure that the educational training program of engineers meet the educational standards". The main focus of the described model is a straight and strong focus on requirements for the graduates' competences. Framework Standards and Guidelines (EAFSG) form the basis for assigning a EUR-ACE® quality mark. They are applicable to all branches of engineering and reflect the diversity of engineering education programs in the European Higher Education Area, which is provided by the education that is necessary for graduates to enter the engineering profession and have a recognized qualification. The standards are divided into: Standards and Guidelines for Accreditation of Engineering Programs and Standards and Guidelines for the Accreditation of Agencies. Standards and Guidelines

for the Accreditation of Engineering Programs include the following requirements:

- requirements to the student workload (workload requirements are described using credits of European Credit Transfer and Accumulation System (ECTS)).
- results of the program (they are described separately for undergraduate and graduate programs with reference to the following eight areas of learning: knowledge and understanding; engineering analysis, designing, research, engineering practice, production of judgment, communication and team work, continuous learning).
- objectives of the program.
- teaching and learning process.
- resources.
- admission of students, transfer, progress and production.
- quality assurance.

Table 2 provides a comparative analysis of the international requirements for the implementation of educational programs. We have highlighted objects of impact of the requirements and monitoring objects.

The main task of the third stage (task 3) was to identify constant and repetitive quantitative evaluation parameters in the international standard of engineering education CDIO. In October 2000, the Massachusetts Institute of Technology (MIT, USA) with the participation of scientists, teachers and industry representatives began a large-scale international project to reform the basic engineering education – CDIO concept (initiative)²².

The purpose of the initiative was to bring content and effectiveness of engineering education programs in accordance with the level of development of modern technologies and the expectations of employers. The initiative should provide an organization of training of students – future engineers so that they can demonstrate deep working knowledge of the technical fundamentals of the engineering profession; an ability to create and operate a new (innovative) technical products and systems; understanding of the importance and strategic value of scientific and technological development of society. Creation and development of products and systems throughout their entire life cycle as a starting CDIO principle forms the necessary context of engineering education. "Idea – Designing – Implementation – Management" serves as a model for the entire product lifecycle.

Table 2. Objects of requirements influence and monitoring objects

Requirements	Objects of influence of standards, requirements and criteria	Monitoring objects at the educational process stage
ESG ENQA [Standards and Guidelines for Quality Assurance in the European Higher Education Area] ¹¹ . Standards and Guidelines for Quality Assurance in the European Higher Education Area] ¹² .	Education quality assurance	Education quality, education quality assurance
ECTS [ECTS Users' Guide. URL: Education and Training] ¹³ .	Educational programs	Educational programs
ISO 9001:2015 [all-Union State Standard R ISO 9001-2015 Quality management systems. Requirements] ¹⁴ . ISO 9001:2015 Quality management systems. Requirements] ¹⁴ .	Education quality assurance	Education quality, education quality assurance
Outcome-Based Approach [Commission presents new Rethinking Education strategy] ¹⁵	Learning outcomes	Education quality
Learning VS Teaching ¹⁶	Training process	Education quality
Student – Centred Education ¹⁷	Training process	Education quality
IEA [International Engineering Alliance] ¹⁰	Educational programs, achievement of learning outcomes and objectives of educational programs	Educational programs, Education quality
CDIO [The CDIO Standards 2.0. URL: Conceive Design Implement Operate] ¹⁸	Education quality assurance at the level of educational programs	Education quality assurance at the level of educational programs, education quality
EUR-ACE [European Network for Accreditation of Engineering Education] ¹⁹	Education quality assurance на уровне образовательных программ	Education quality assurance at the level of educational programs, education quality
EMF [Accreditation.org. Engineers' Mobility Forum 2001] ²⁰	Engineering competency model, qualification framework	-
APEC Engineer Register [APEC Engineer Register] ²¹	Engineering competency model, qualification framework	-

In January 2011, CDIO initiative adopted 12 educational programs standards. These standards have been developed to help managers of educational programs, graduates and industries in order to align with the principles according to which professional and public recognition and measurement of CDIO programs and their graduates will be carried out. The designed CDIO standards define the distinctive features of CDIO programs and act as "a guide" while conducting educational reforms and implementing evaluation of their effectiveness. Standards specify which goals and objectives should be set by the university to achieve professional and public recognition.

Standards 11 and 12 describe audit and evaluation of program and students' progress. Standard 11 defines the need for adaptation during implementation of educational program of adequate evaluative methods of learning

outcomes, which form graduates' professional, personal and interpersonal competence. Standard 12 provides the availability of the system of evaluation of educational program conformity at the university to the CDIO concept and providing feedback with students, teachers and other stakeholders to continuously improve the program.

The implementation of CDIO standards generally involves monitoring the implementation of standards' requirements. Special methodology "Section" is used for this. Section is the scale (6-point) of criteria, which allows evaluating the level of compliance with the requirements of each standard. Section presents evidences of compliance with each of the levels. Sections are presented in a hierarchical order: each successive level includes the previous ones.

Thus, one of the most important tasks of a multidisciplinary university as a supporting institution in the region is to provide quality monitoring system of engi-

neering education, reflecting the requirements of the methodology of "Sections".

Task 4. It is the above mentioned that determined the content of the following task: to relate the requirements of a specific methodology "Section" with the RAEE requirements, on the basis of which to present experience of administrative actions for establishing the system of monitoring education quality and quality assurance in Transbaikal State University.

Characteristics of complex and innovative engineering problems on the basis of which the RAEE requirements for the competence of bachelors, masters and specialists are formulated, are shown in Table 3²³.

The solution of complex engineering problems is a problem field of bachelors training in technical areas.

Characteristics "a wide range of different engineering and other issues" is a complex engineering task involving different areas of knowledge. Characteristics "has no obvious solution, requires abstract thinking, original analysis and relevant models" requires solving complex engineering problems using simulation methods, in most of the cases – mathematical ones. Characteristics "requires knowledge solutions, allowing using an analytical approach based on the fundamental principles" suggests that the analysis of, for example, processes in the technical object should be made directly with the use of physical laws that form the basis of its operating principle. Characteristics "includes not common tasks that are outside of standard solutions" means the need for using engineering tasks, which are not typical, and for which there are no standard procedures. Characteristics "covers a variety of stakeholder groups with a wide range, including conflicting requirements" meet the general objects of

engineering activities, consumers of which are different industries. Characteristics "has significant contextual effects" means that the solution of complex engineering problem has the impact on environment, social sphere, economy and others, related to techniques and technologies. Characteristics "is a multi-component problem" notes the existence of various factors that influence the solution of complex engineering problem.

Specialists and masters usually deal with atypical tasks including requiring, for example, the design of specific components while developing a new technical facility. Thus, the solution of engineering innovation problems is a problem field of training of specialists and masters in technical fields and professions.

The concept of "specialized" relates to the problem of a narrow area of expertise. Characteristics "has no unambiguous solution, requires deep analysis and high-level models" requires innovative engineer problem solution using optimization methods and mathematical models based on complex systems of equations for finding the optimal solution. Characteristics "requires an interdisciplinary basis and combination of deep fundamental and applied knowledge for solving a problem, their use in an "unexpected way" means, for example, that the technical subject of a new type is created through simultaneous application of innovation in the design, control scheme, using new materials, etc., the combination of which leads to a synergistic effect. Characteristics "focuses usually on target stakeholder group" is associated with innovative engineering activity, for example, if creating a new generation of technical objects, including narrowly specialized, designed for the use within certain technical devices and technological facilities in certain sectors. Characteristics

Table 3. Complex and innovative engineering problem characteristics

Complex Engineering Problem	Innovative Engineering Problem
<ul style="list-style-type: none"> - a wide range of different engineering and other issues; - has no obvious solution, requires abstract thinking, original analysis and relevant models; - requires knowledge solutions allowing using an analytical approach based on the fundamental principles; - includes not common tasks that are outside the standard solutions; - covers a variety of stakeholder groups with a wide range, including conflicting requirements; - has significant contextual effects; - is a multi-component problem 	<ul style="list-style-type: none"> - is a complex engineering task, involving different areas of knowledge; - has no unambiguous solution, requires deep analysis and high-level models; - requires an interdisciplinary basis and combination of deep fundamental and applied knowledge to solve a problem, their use in an "unexpected way"; - as a rule, includes not common tasks that are outside of standard solutions; - focuses usually on target stakeholder group; - has significant contextual effects; - is multi-level

"has significant contextual effects" requires taking into account that solving innovative engineering problem qualitatively improves techniques and technology, as well as influences environment, social sphere, economics and others related to them. Characteristics "is multi-level" is associated with innovative engineering problems whose solution is performed on the basis of solving a number of problems at different levels.

Criteria for accreditation of RAEE higher education programs are: 1. the objectives of the program and the learning outcomes, 2. the program content, 3. the organization of educational process, 4. teaching staff, 5. training for professional activity, 6. program resources, 7. graduates²³.

These criteria of professional and public accreditation of educational programs used by RAEE when evaluating their quality are a guide for the design of layered engineering programs that meet international standards.

Provide an example of correlation of specific methodology "Section" requirement with the RAEE requirements on example of criterion 3 for the specialty programs "Organization of educational process" (Table 4).

Evolution of the system of monitoring education quality and quality assurance has defined current policy provisions of Transbaikal State University in the field of quality as the processing of an external independent evaluation of the quality procedures. The administrative activities resulted in the design of the system of monitoring education quality and quality assurance at the university.

The purpose of monitoring the education quality and quality assurance at the university (hereinafter – monitoring) is collection, compilation, analysis of information on education quality and education quality assurance at the level of educational programs to identify trends and quality development of the university, make informed management decisions to achieve the objectives in the quality area.

To achieve this goal, the following tasks are performed:

- formation of the mechanism of the unified system for collecting, processing and storing information;
- coordination of activities of all monitoring participants;
- rapid identification of the problem areas and drawing up preventive action plans;

Table 4. Section according to the "Educational process organization" criteria

Criteria	Number of points
Students accepted to the program must have secondary general or vocational education at least.	1
Students accepted to the program must have a sufficient level of scientific and mathematical knowledge required for acquiring a program. A system of academic adaptation, ensuring the development of an educational program should be foreseeing or students with a basic training below the average level	2
The educational process should ensure achievement of learning outcomes by all students. The educational organization must have a mechanism for continuous monitoring of the educational plan implementation and achieving the planned training results by students as well as effective feedback to improve the content and technology of the educational process	3
An important factor is the use of active learning techniques and the organization of students' independent work with the use of open educational resources, placed, among others, on the Internet-site of the organization	4
An important factor is the availability of personality-oriented educational environment and students' participation in the formation of individual educational plans in the educational organization	5
An important factor is an academic mobility providing students studying a variety of disciplines (modules) of the educational plan, practical training and training in other educational and research institutions, as well as at the country's enterprises and (or) abroad	6

- rapid identification of inconsistencies and making corrections and corrective action plans;
- identification of the factors influencing the education quality, adoption of measures to remove the adverse effects;
- formulation of the main strategic directions of the university development on the basis of the obtained data analysis;
- using the results to determine the performance quality of specific business units.
- Monitoring is carried out on the following principles:
- objectivity, accuracy, completeness and systematicity of information;

- reality of requirements, standards and indicators of quality education, their social and personal importance;
- openness, transparency of monitoring procedures;
- continuity in education policy, integration into all-Russian system of monitoring education quality assurance;
- availability of information on the status and quality of education for different groups of consumers;
- reflexivity, realized through the inclusion of employees in the criteria introspection and self-esteem of their activities based on objective criteria and indicators;
- increase in the internal evaluation capacity, self-esteem, self-awareness of each process;
- optimal usage of primary data sources to determine the quality and efficiency of the university activity (with the possibility of multiple use);
- instrumentality and processability of the used indicators (taking into account the existing possibilities of data collection, measurement methods, analysis and interpretation of data, stakeholders' readiness to their perception);
- minimizing the scorecard considering the needs of different levels of government;
- mutual complement of evaluation procedures, establishing between them of interactions and interdependence;
- compliance with ethical standards while conducting monitoring procedures at the university.
- The next challenge was the isolation of objects of the system of monitoring education quality and quality assurance to which we have referred:
 - management processes;
 - main processes;
 - supporting processes;
 - subdivisions;
 - education programs;
 - the teaching staff activities;
 - student learning results.

Depending on the object of monitoring, the following types of monitoring are distinguished: according to process, structural units, personal. Depending on the frequency of monitoring, the following types are distinguished: periodic, resulting, situational.

Monitoring involves the extensive use of modern information technologies at all stages of collection, processing, storage and use of information.

Implementation of process of monitoring education quality and quality assurance has actualized the problem of the selection of evaluation methods: relative and absolute.

Relative valuation methods are divided into the following four types of evaluation: evaluation of paired comparison, ranking evaluation, evaluation with constant amount and evaluation with Q-sort method.

Paired comparison. Paired Comparison Scale is a relative method of evaluation in which two objects are presented to respondents and they are asked to select one of them according to the given criterion. In general, the presence of N products/services results in the $N(N-1)/2$ comparisons. The resulting comparison data can be presented in a table by dimension $N \times N$.

Another method of obtaining data using a paired comparison is obtaining a preference ratio of one product/service to another. Paired comparison is useful when the number of types of products/services is limited and when direct comparison is necessary.

Ranking. Ranking evaluation is a relative method of evaluation in which several objects (products, services) are presented at the same time to respondents asking them to sort and rank them according to the predetermined criteria. Sorting or ranking may be based on preferences, attractiveness, relevance, effectiveness, etc. Starting from the selection of the most attractive type of product, respondents assign it number 1. Then they find a second type of product on the degree of preference for them, etc. It is important that the two types of products were not on the same level. When performing ranking evaluation, only $(N-1)$ solution should be taken.

A scale with a constant amount. With the scale with a constant amount, respondents are given a certain amount of units, for example, points, and respondents are asked to distribute them among various objects (products, services). For example, they can be asked to reflect the degree of preference, importance, or other characteristics of the product and give it a score of 100 for the distribution among different products. If the characteristic of one or another product is not important for respondents – they can associate it with 0 points. When the points distribution is completed – the sum of points associated with all the products, must be equal to 100 or a fixed amount. Correlation of data obtained during the evaluation with a constant amount, is the most powerful, because it allows characterizing the evaluation associating with it the amount of points that allows evaluating the differences between the alternatives.

Q-sorting. Evaluation by Q-sorting is a relative evaluation type in which the respondent is asked to sort a large number of objects (products and services), and to classify them into a predetermined small number of sets according to certain criteria, such as preference, provision or behavioral characteristics. In order to increase statistical confidence, from 60 to 140 should be used for the classification of objects sets (usually not more than 11 sets). This approach is appropriate for fast processing of large groups of items.

Absolute methods of evaluation are often called as monadic assessments, since only one object is simultaneously measured. With this approach, there are no comparisons with other objects. Absolute methods of evaluation are divided into two classes: evaluation with continuous scale and with detailed scale.

When evaluating with a continuous scale, the respondents are asked to evaluate by issuing notes on a continuous line. They mark, for example, the perceived level of characteristics of a particular product with the sign “*” from the negative “very bad” to the positive “very good”.

When evaluating with detailed scale, respondents have a scale associated with the categories of a number and/or a brief descriptions, and they are asked to select one of the categories. Evaluation with detailed scale is very flexible.

Method for evaluating the education quality level can be differential, integrated or mixed.

Differential method consists in comparison of individual quality indicators of evaluated object with the appropriate base sample rates. At the same time, it is determined whether the quality of the evaluated object reaches the quality of the basic sample as a whole. Also, it is specified which individual indicators exceed or do not comply with quality parameters of the basic sample, and to what extent the individual performance properties differ from each other.

Differential method of quality evaluation allows evaluating the object by such quality categories as “exceeds”, “meets” or “does not meet” to a certain level of quality of the same object. At the same time, with the differential method of evaluation, the individual properties of the object are quantitatively evaluated that allows taking concrete decisions on the object quality management.

Complex method of quality evaluation involves the use of an integrated (generalized) quality score. This method is used when it is necessary to express the level of quality by a single number. The quality level of the integrated method is determined by the ratio of the

generalized indicator of the quality of the evaluated object to the generalized indicator of the basic sample.

The essence of the mixed method consists in a sequence of actions:

1. All or a part of individual quality indicators are combined into a group, for which the group (complex) indicator is determined. The most important and characteristic individual indicators may not be included in the groups, but treated on a par with the group.
2. The numerical values of the obtained group (complex) indicators and individually accounted simple indicators correlate to the relevant benchmark, i.e. the principle of differential method object of quality evaluation is applied.

The above-mentioned analysis of education quality evaluation showed that the gathering of information for monitoring system is carried out by interview; surveillance; questionnaires; statistics; reporting; expert interviews; analysis of documents; self-esteem. Standardized and non-standardized, formalized and non-formalized evaluation indicators, reporting forms are used as a tool. Completeness and depth of management tasks on the selection of methods for the system of monitoring education quality and quality assurance at the university are provided with a complex of monitoring indicators sources distinguished by us:

- documented QMS procedures;
- indicators of self-examination;
- indicators of monitoring effectiveness;
- indicators of PPP activities;
- statistical reporting of authorities of different levels;
- information card about the performance of research work indicators;
- indicators of state accreditation;
- indicators of vocational and public accreditation;
- indicators of various competitions;
- evidence of internal audits;
- products of students' educational activity;
- students' portfolio;
- educational-methodical documentation;
- observational evidence;
- reviews of employers and others.

The frequency and procedures for monitoring is established by the QMS relevant documented procedures, the

normative acts of the Ministry of Education and Federal Education of the Russian Federation and the Science Supervision Service, local acts of the university. Process owners are responsible for monitoring.

Implementation of monitoring involves a sequence of the following administrative actions:

- Definition and justification of monitoring facilities.
- Data collection for monitoring.
- The creation and structuring of database for storage and operational use of the information.
- Data processing.
- Data analysis and interpretation.
- Preparation of conclusions based on data analysis.
- Bringing the monitoring results to the attention of interested parties.

As a result of the internal analysis of the monitoring data, the relevant documents (reports, certificates, reports) are prepared, which are communicated to the employees and management of the University, as well as placed on the university website for the general public. Monitoring results are the basis for administrative decision-making at the university level, providing both reliability and stability of its functioning as well as the development prospects.

4. Discussion

The aim of the study was the problems related to the monitoring of higher education quality. We have tried to illustrate the practical aspects of these problems on the example of engineering education. This consideration makes it possible to distinguish general problems of ensuring management activity in higher education and show the industry specificity of organizing and conducting monitoring studies.

Transbaikal State University has come a long way to build the system of monitoring education quality and quality assurance, beginning with those or other management decisions. One of the provisions of the university's policy relating to quality is holding external independent quality evaluation procedures on a regular basis. As a result of active management actions in this direction was the successful completion of various external assessment procedures. Transbaikal State University has a vocational and public accreditation in six educational programs of three accreditation bodies: Association for Engineering Education of Russia, Agency for Higher Education Quality Assurance and Career Development, Association of Lawyers of Russia.

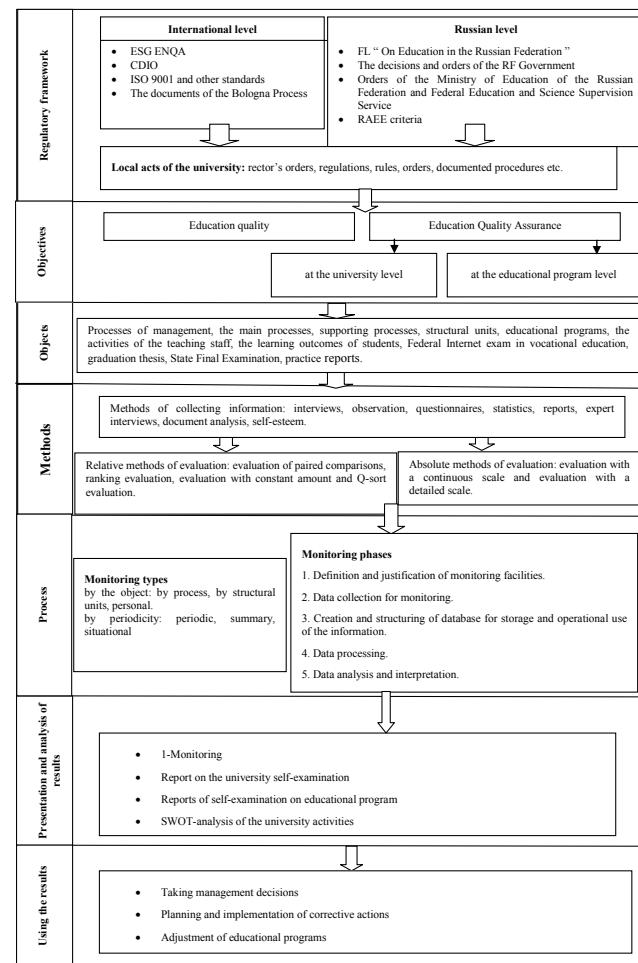


Figure 1. System model of monitoring education quality and quality assurance

As a result of constant interaction with external stakeholders, conducting self-examination procedures according to the international and Russian standards, the system of monitoring education quality and quality assurance at the level of educational programs has been developed at the university (Figure 1).

The presented model of the system of monitoring education quality and quality assurance is the result of coupling the existing traditional model of monitoring with a new content of vocational and public examination of quality and education quality assurance at the university.

5. Conclusion

Thus, the analysis of the methodological foundations of international practice has shown the relevance of the selected items in determining the grounds and trends in

the construction of a monitoring system, both of national and high school levels.

Comparison and evaluation of analyzed approaches and models have been differentiated according to their characteristics. This context allowed, on the one hand, making a formal correlation of models selected for analysis with the system of monitoring education quality and quality assurance at the university in accordance with the RAEE criteria and standards and, on the other hand, taking into account the diversity of the considered evaluation systems.

To create the system of monitoring engineering education quality at the multidisciplinary university as a supporting institution in the region, it has become necessary to relate the requirements of the methodology "Section" with the RAEE requirements.

Experience in creation of the system of monitoring education quality and quality assurance at the Baikal State University has shown that the construction of the system and its operation begins with administrative decisions, and management decisions present its "output".

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