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Development of Integrated Management System in the Engineering School

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The article relates to integration of quality management systems of the university and the testing laboratory which is a part of the university according to the accreditation requirements to laboratories within the framework of the national accreditation system. It studies alternatives, areas, and degrees of the integration, and suggests a standard approach to IMS (Integrated Management System) based on ISO 9001 and ISO/IEC 17025 to eliminate possible risks in accreditation and allows achieving goals of the integrated management systems.

Key words: integrated management system, university, testing laboratory, accreditation, integration area.

Development of integrated management system (IMS) at universities has been actively discussed for the recent 5-7 years. A number of Russian universities – from technical to pedagogical ones – have already introduced and certified the IMSs based on diverse universal standards, such as ISO 9001, ISO 14001, OHSAS 18001, which is analogue of SA 8000, more rarely ISO/IEC 27000, applied to information security management systems. More and more universities have certificates for several management systems. Such trend proves the growing interest of universities in increasing efficiency of their work.

The reasons that induce Russian universities to implement IMS are different: some are aimed at enhancing the image of a university in the eyes of regulatory authorities and employers; others hope to be more compatible in grants and programmes, which makes an important part of university's image. There are other reasons that are not so clearly defined, for example: to implement the ways to solve problems of social responsibility and business ethics in academic community by introducing declarative provisions of ISO 26000 and its analogues.

The validation of new approaches in the framework of university IMS is delivered in research publications [1–3]. However, the analysis of the publications relating to the university IMS shows that the reasons for a university to choose ISO 14001, for example, to be implemented are not well grounded. Doing research work, universities do not produce emissions that would have negative impact on the environment. Thus, a university will not be able to identify the environmental aspects of its activity and to assess their importance in terms of legislation requirements, stakeholders, and risks (frequency, scale, severity of consequences, costs, control lost etc.). While determining these aspects a university should be governed by reasonable practicality, that is to limit itself to the aspects that can be justifiably controlled (first of all in terms of their relevant environmental impact). The university should not start implementing the requirements of the environment management system without assessing their relevance.

The integrated management system results from synergetic interaction of systems targeted at different spheres and applied to any organizations (universal standards of management system) and to organizations of particular industry (industrial standards of management system). The latter ones include the standards developed on the basis of ISO 9001 to be applied in particular industries, automobile – ISO/TS 16949, food – ISO 22000, petroleum industry – ISO/TS 29001, etc. The infrastructure of the international standards, used while developing IMS, can be developed by means of international standards for computerized scheduling systems, production and process modeling management (MRP, MRP II, ERP, CSRP, CALS, ARIS, IDEF, etc.), as well as standards for risk management, knowledge and assets management. However, though being aimed at increasing management efficiency, these standards are the tools to solve only technical tasks; thus, they can be regarded only as supporting tools for an organization to develop a system of continuous activity enhancement [4].

It is obvious that IMS should not be identified with the system of general management that unites all the activity aspects of the organization. In this regard, the notion "integrated management system" is of limited character, though being more complex than the notion about each separate management system united in IMS. Even with implementing all universal and industrial standards, IMS cannot substitute the system of general management, since it does not still include financial management, personnel management, innovative management, securities management, etc. The notions "integrated management system" and "system of general management" can be identical only after the standards for all spheres related to the general management are developed. Thus, it is reasonable to assume that IMS development will not be completed unless all the aspects of the general management are standardized, which is a dim and long process.

However, the relevance of developing highly integrated management system is doubtless. There are a number of obvious reasons [5]:

- IMS ensures more coordination inside the organization, thus adding to a synergetic effect, which means that coordinated actions lead to better result than the sum of separate results (according to Aristotle's paradox "one plus one is more than two");
- IMS minimizes functional lack of cooperation that results from development of separate management systems in the organization;
- IMS development is less labour consuming than development of several parallel systems;
- The number of internal and external connections in IMS is less than the total number of the connections in several systems; the amount of documents in the integrated system is much less than the total amount of documents in several parallel systems;
- IMS ensures high involvement of the staff in the activity enhancement;
- IMS can take into account the balance of external stakeholders' interests more effectively than the parallel systems can do;
- Costs for development, functioning and certificate of IMS are lower than the total costs for several management systems.

As practice shows, there are a number of ways to develop and implement IMS [6]:

- To develop additive IMS models; the system of environmental management (SEM), OHSAS, etc, are successively added to the quality management system (QMS). When using this way the gap between the introductions of the systems can vary from 6 months to several years;
- To develop fully integrated system; all management systems are united in one unit simultaneously. Though having obvious organizational and economical benefits, this way is still rarely used since it is difficult to be implemented.

The unified international standard for IMS implementation has not been developed yet. However, there are two documents that can serve as a base for such standard. It is a guide for ISO 72:2001 «Guidelines for the justification and development of management system standards», and PAS 99:2006 «Specification of common management system requirements as a framework for integration».

ISO 72:2001 has terminology, structure,

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common elements of standards for management systems that can be developed by specialists of ISO departments and agencies. The guideline recommends using a widely known PDCA cycle and keeping to the process approach that is a base for ISO 9001.

PAS 99:2006 was developed with regards to ISO 72:2001 used for any new management system. PAS 99:2006 describes the system that would take into account common and specific requirements for management system standards.

Russian requirements to IMS are determined in national standard GOST P P 53893-2010 «Guidelines and requirements for integrated management systems». Certification association "Russian register" developed the rules to integrate management systems, based on the experience in certification activity.

Inefficient implementation of separate management systems (quality-, environmental management etc.,) and their integration lead to significant expenses and loss of stakeholders' confidence. IMS can effectively be implemented only on a new scientifically-grounded base, since this task is complicated and risky. Taking into account the culture level, it is reasonable to apply the additive IMS model described above.

While implementing INS in universities, there arise a number of problems to be solved:

- How can universities use the experience of other industry sectors in IMS development?
- How can the balance of all stakeholders' interests be kept while introducing IMS?
- How can IMS be developed to ensure efficient university activity and meet interests of all stakeholders?

It is of special interest for Kuban State Technological University to develop the additive IMS that takes into account specific work of testing laboratories that are part of the university. The activity of the laboratories is regulated by ISO/IEC 17025 and undergoes accreditation procedure by Rosaccreditatia according to the criteria established by the order of the Ministry of economic development of Russia no. 326, dated 30.05.2014.

Studying the market for food safety testing services, we observe the increase in the number of universities that provide the services of testing centers, which can be explained by a number of reasons:

- increase in the amount of domestic production and imported goods of the Custom Union countries;
- active work of EAEC structures to develop and introduce the Custom Union regulations for food industry, in particular, including nutrient additives, dietary products, packages, and labels;
- scientific aspect is taking more and more leading position in providing Master degree and post graduate degree programmes. Their quality is assessed in terms of efficiency of scientific innovative activity. Performance criteria for scientific innovative activity of universities are monitored by the Ministry of Education and Science on an annual basis.

QMS of a testing center ensures its efficient work. Efficiency is an essential prerequisite for survival in severe competition on the service market. Efficient QMS of the testing center should be an obvious benefit not only in the Russian but also the EAEC markets.

One of the six university testing centers that provide conformity assessment is Testing Center "Food Safety", Kuban State Technological University. It is certified by Rosaccreditatia. The Testing center provides the following services within the framework of its accreditation:

- to control quality and safety criteria for food, food commodities and feed;
- to control quality and safety criteria for foodservice industry;
- to control quality and safety criteria for perfumes and cosmetics;
- to conduct microbiological tests, including those for sanitary-indicative microorganisms.

The Testing Center (TC) is regularly accredited according to the Rosaccreditatia requirements. The QMS of TC is independent (quality policy, system-wide procedure, "dependent" internal audit, etc.) and developed to meet ISO/IEC 17025 requirements. At the same time, TC is a structural division of Kuban State Technological University (KubSTU) and can use system-wide procedures of KubSTU QMS that comply with ISO 9001 and are required by ISO/IEC 17025. It makes it necessary to integrate two systems in one to ensure both ISO 9001 and ISO/IEC 17025 compliance.

Nowadays, there is no unified conceptual approach to the additive IMSs. The guidance to IMS implementation in universities has not been developed yet. To facilitate the integration of TC QMSs in KubSTU QMS, a standardized approach to the additive model of university IMS based on integration of ISO 9001 and ISO/IEC 17025 has been developed.

To achieve the integration goals, the following tasks were performed:

- to study the regulatory documents of Rosaccreditatia relating to testing centers (laboratories) accreditation and international standards with respect to conformity assessment;
- to study the experience of TCs accreditation in the CIS;
- to compare QMS procedures and documents of KubSTU and TC;
- to choose areas and degree of IMS integration, to develop KubSTU IMS structure that includes interaction of processes, integrated activities and documents;
- to describe the TC process "Assessment of compliance";
- to develop the procedures of the integrated audits that would meet the integrated requirements of the Ministry of Education and Science, Rosaccreditatia, and IMS annual report.

According to the Federal Act "On accreditation" No. 412-FZ of 28 December 2013, certification bodies and testing laboratories should be technically competent. The order of the Ministry of Economic Development of Russia No. 326 of 30 May 2014 "On Approval of the accreditation criteria and the list of documents to confirm the applicant's compliance with the accreditation criteria" contains the requirements to the technical competence and quality management system of a testing laboratory. These requirements are necessary to ensure technically grounded data and test results. The order contains reference data on the standards for compliance assessment, ISO/IEC 17025 in particular, the provisions being included in the criteria in interpreted form. Additional requirements of the national accreditation system are to confirm legal ownership of premises, testing equipment and other facilities (par. 21), and ensure measures to prevent interest conflict (par. 23.4). The QMS documents of a testing laboratory, apart from the required according to ISO/IEC 17025, are to include employers' viewing the documents, administration of database for all external regulatory documents (par. 23.7), the rules to describe corrective measures (par. 23.17), and use of the national accreditation system label (par. 23.22).

To develop additive model of university IMS, integration areas were determined, that is a combination of integrated standards with the most similar features. These elements are summarized in table 1.

The comparative analysis shows that GOST ISO/IEC 17025 and Accreditation criteria do not implement a process approach, and the latter do not have the requirements for customs' satisfaction assessment. While the elements being integrated, the university's limits in IMS implementation were taken into account. They are related to the availability of resources to implement the integration and the willingness of the TC to change: how deeply the TC personnel understand the integrated approach and customs' survey.

The TC does not determine processes in the QMS. However, the test results provided to a customer are the results of its activity that has all characteristics of a process – repeated interacted and interconnected activities that transform input into output, and other characteristics of a process [7]. The sample testing for compliance assessment includes the following stages:

- to make contract for testing;
- to choose methods of testing;
- to prepare for tests;
- to perform tests;
- to make a protocol of tests.

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Table 1. Requirements to the key elements of IMS in ISO 9001 and ISO/IEC 17025 and accreditation criteria

QMS element	ISO 9001	ISO/IEC 17025	Accreditation criteria
Quality policy	+	+	+
Quality goals	+	+	+
Process management	+	–	–
Document management	+	+	+
Quality manager	+	+	+
Management of monitoring and measuring equipment	+	+	+
Management analysis	+	+	+
Consumer satisfaction	+	+	–
Internal audit	+	+	+
Continuous improvement	+	–	–

Fig. 1. "Compliance assessment" process layout

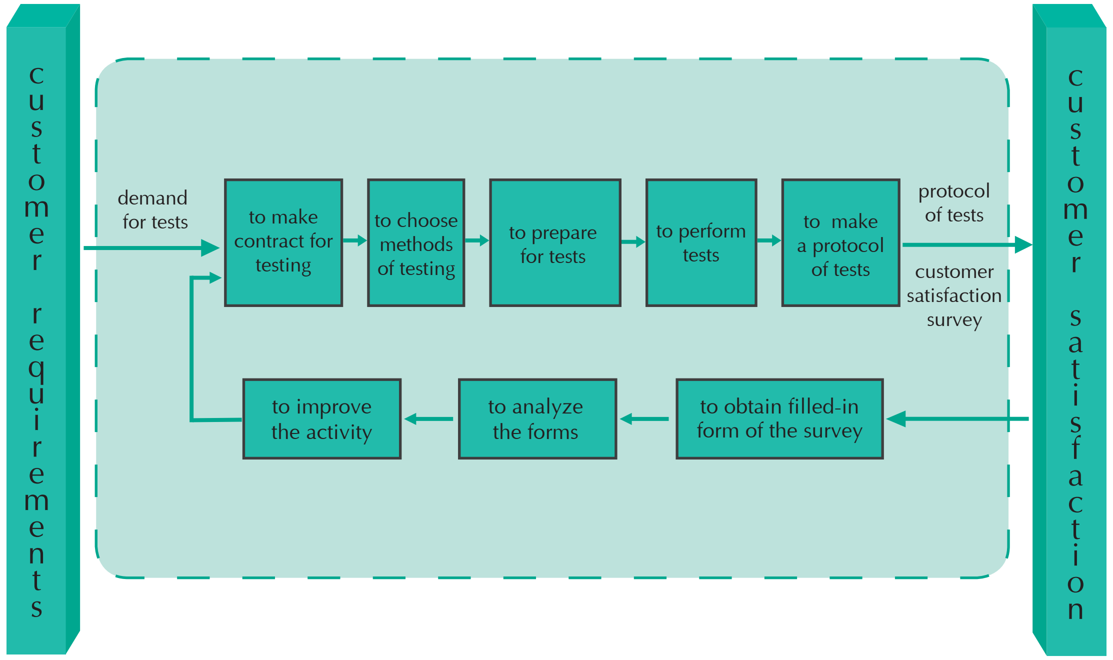

Table 2. Monitoring and measuring criteria for "Compliance assessment" process

Process stage	Indices of the process and its target value
to make contract for testing	The contract is made (yes/no) Agreement deadline (no more than 2 days)
to choose methods of testing	The possibility to perform tests with the equipment available at TC and approved for use by the guidance (yes/no)
	Compliance with the accuracy characteristics of the testing procedure required for the tested sample (yes/no)
to prepare for tests	Compliance with the required environmental conditions (yes/no)
	Availability of all the necessary certified standard samples, reagents and materials (yes/no)
	Calibrated measuring facilities and certified equipment (yes/no)
to perform tests	The accuracy of parallel test results complies with the required value (not less than 2)
	Assessment of test result adequacy (yes/no)
	The final test result is compared with the standard sample values (yes/no)
	The requirements for terms of service provision are met (yes/no)
to make a protocol of tests	The number of mistakes in the test report (no more than 1 mistake that does not interfere with the test results)
	The test report is delivered to the customer within the period established by the contract (yes/no)
	The customer is satisfied with the service quality (satisfaction rate is not less than 70% according to the survey)

"Compliance assessment" IMS process and the criteria are shown in fig. 1 and in table 2.

The suggested approach to IMS allows reaching the following degree of integration:

- a unified system coordinator who uses unified approaches to the whole management system;
- a common harmonized quality Policy added with responsibilities of TC relating to compliance assessment services;
- a unified and well-balanced planning framework, goal setting and reporting processes;
- unified system-wide QMS procedures required by the integrated standards;
- a unified database that includes a QMS register and documents available for all users;
- a complex system that ensures optimal provision of all resources and facilities;
- a unified system for staff training and development;

- a unified programme of internal audits and social surveys;
- an annual QMS analysis is carried out with regard to TC activity assessment according to the process "Compliance assessment".

IMS implementation optimizes functions and flow of documents, thus breaking down the barriers and saving IMS costs. We keep to the following principles: not to destroy the existing QMS of TC, to minimize all possible accreditation risks, and to ensure the possibility of increasing the volume and quality of the services provided as well as its work efficiency. Positive results from IMS implementation can only be obtained on condition that the TC management team and all the staff are involved in the process.

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Socially Oriented Approach: Professional and Personal Competencies of Engineering Graduates

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The paper addresses development of engineering graduates' competencies in terms of social position rather than economic, traditional, viewpoint. It emphasizes the importance to develop internal University culture that brings up engineers' responsible attitude to their professional activity. The authors provide some survey data related to TPU students' internal culture research.

Key words: university graduate's competencies, responsibility, university internal culture, engineering education, engineer.

"The first duty of the university is to teach wisdom, not a trade; character, not technicalities".
W. Churchill

Today, the concept "engineer" implies three categories of people [1].

The first category embraces people who occupy engineering positions. They should meet the requirements set both by the government regulations and industry-specific regulatory documents.

For example:

- Third grade engineer: higher professional (technical) education, work experience is not required; or vocational (technical) education, not less than three-year work experience in a position of the first grade technician or other positions (not less than five-year work experience for vocational degree holders).
- Second grade engineer: higher professional (technical) education, three-year work experience in a position of an engineer or other engineering positions.
- First grade engineer: higher professional (technical) education, not less than three-year work experience in a position of a second grade engineer.

The position of an engineer is gradually vanishing in Russia. It is replaced by such posts as "specialists", "expert", etc.

The second category involves people who graduated from the university with a degree in engineering or were accredited by a professional-public accreditation agency after submission of all required documents or passing corresponding exams.

The first group of people within this category embraces those who had graduated from university before Russia adopted a two-tier (Bachelor, Master) degree system. In reality, the two-tier degree structure of education system was adopted by some Russian universities in 1993, though Russia signed the Bologna Declaration in 2003. In 2011, Russian universities eventually moved to the two-tier bologna system of education. This group comprises the working age population.

The second group is a relatively new phenomenon. In Russia, it appeared approximately in 2011. It is worth noting that the degree of engineer has been awarded in the western countries (with exception of Germany) by definite professional-public accreditation agencies for a long period of time. Western universities have never awarded their students such a degree. In