

Approved by  
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**REPORT**  
**on the results of the external evaluation of the educational program**  
**“Information-measuring equipment and technologies in innovative**  
**industrial projects”**  
**Master’s Degree**

**South Ural State University (National Research University)**

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## PROGRAM SUMMARY

The educational Program "*Instrument engineering*" (the program profile (orientation): "*Information-measuring equipment and technologies in innovative industrial projects*") is implemented in the training field 12.04.01 "*Instrument Engineering*" by the Chair of "*Information-measuring equipment*" of the structural unit of the Federal State Autonomous Educational Institution of Higher Education "South Ural State University (National Research University) *Higher School of Electronics and Computer Science* and this Program graduates are awarded a Master's degree. The management of the Program is carried out by *Sergey Nekrasov*, professor of the *Chair of Information-measuring equipment*.

A site visit as part of the external evaluation of the educational program was carried out by an AKKORK expert from October 8 to 9, 2019.

### ***Strengths of the analyzed program***

- modern educational and laboratory base in the field of information-measuring equipment;
- a wide selection of enterprises - the bases of practice and, as a result, a practically oriented character of term papers and graduate qualification works;
- a high level of accounting in the main educational program (hereinafter referred to as EP) for the specifics of the regional enterprises' activities;
- one hundred percent indicator of the graduates contingent employed in the region within one year after graduation in the field of training;
- the practice of questioning employers on the completeness competencies formation of the program graduates;
- high loyalty of the teaching staff to the HEI;
- students involvement in research work, starting from the first year;
- introduction of the results of scientific works and master classes conducted by representatives of enterprises (employers) into the educational process;
- programs of General professional and Special disciplines include modern achievements of science, technology, technology and management, including production, in the training field
- introduction of the "Barrier-free environment" system, the main purpose of which is to create conditions for the provision of inclusive education for people with disabilities in higher education programs;
- the educational process intensification ensuring and, as a consequence, the students' cognitive activity activation through regular knowledge monitoring through the use of a point-rating assessment system;
- the share of classes conducted in an interactive form in the program exceeds 70%;
- international experience of scientific work of teaching staff;
- student participation in project training;

- the functioning in the organization of a large number of projects and structural units which activities are aimed at the formation of students personal qualities;
- various internship programs lasting from one semester to several semesters, additional professional education (advanced training and professional retraining);
- availability of Department of practice and employment of students;
- a large number of various career guidance events to attract Russian and foreign applicants;
- pre-Master and pre-postgraduate training with the participation of potential applicants in international student programs.

***Weaknesses of the analyzed program:***

- the inertness of the internal monitoring system of education quality;
- the predominance of testing materials developed on the basis of theoretical material (see clause 7 of criterion 3 of the self-evaluation report);
- only about 20% of students believe that their opinion is taken into account when developing the main educational Program (EP) and updating teaching and learning aids (hereinafter - TLA) (see the results of the survey submitted by the educational institution);
- 10 people are involved in the implementation of the professional disciplines of the main educational program, of which only 4 people (40%) combine work in an educational organization with professional activities in the specialty and only 3 people (30%) have experience according to the profile of the implemented discipline (see self-evaluation report).

***Main recommendations for the analyzed program***

- activation of the Program management activities on concluding training agreements at the expense of legal entities (including targeted training agreements), in particular with the strategic partner of the program of company Industrial Group Metran (Chelyabinsk);
- the teaching staff stimulation to practical work on the taught disciplines profile, including the incentive system and bonuses;
- development at the faculty (in the Dean's office) of a documented system for the consideration of students' appeals and complaints; feedback system based on the results of students' assessment of the taught disciplines;
- increasing the depth of the annual actualization of the main educational program and the teaching and learning aids complex of disciplines (in the paradigm of the competency-based approach), taking into account the requirements of existing normative legal acts and standards;
- introduction of new educational technologies recommended by the EP reviewer into the educational process (see page 2 of the Review of the educational program in the field of training 12.04.01 Instrument-Engineering, signed by the

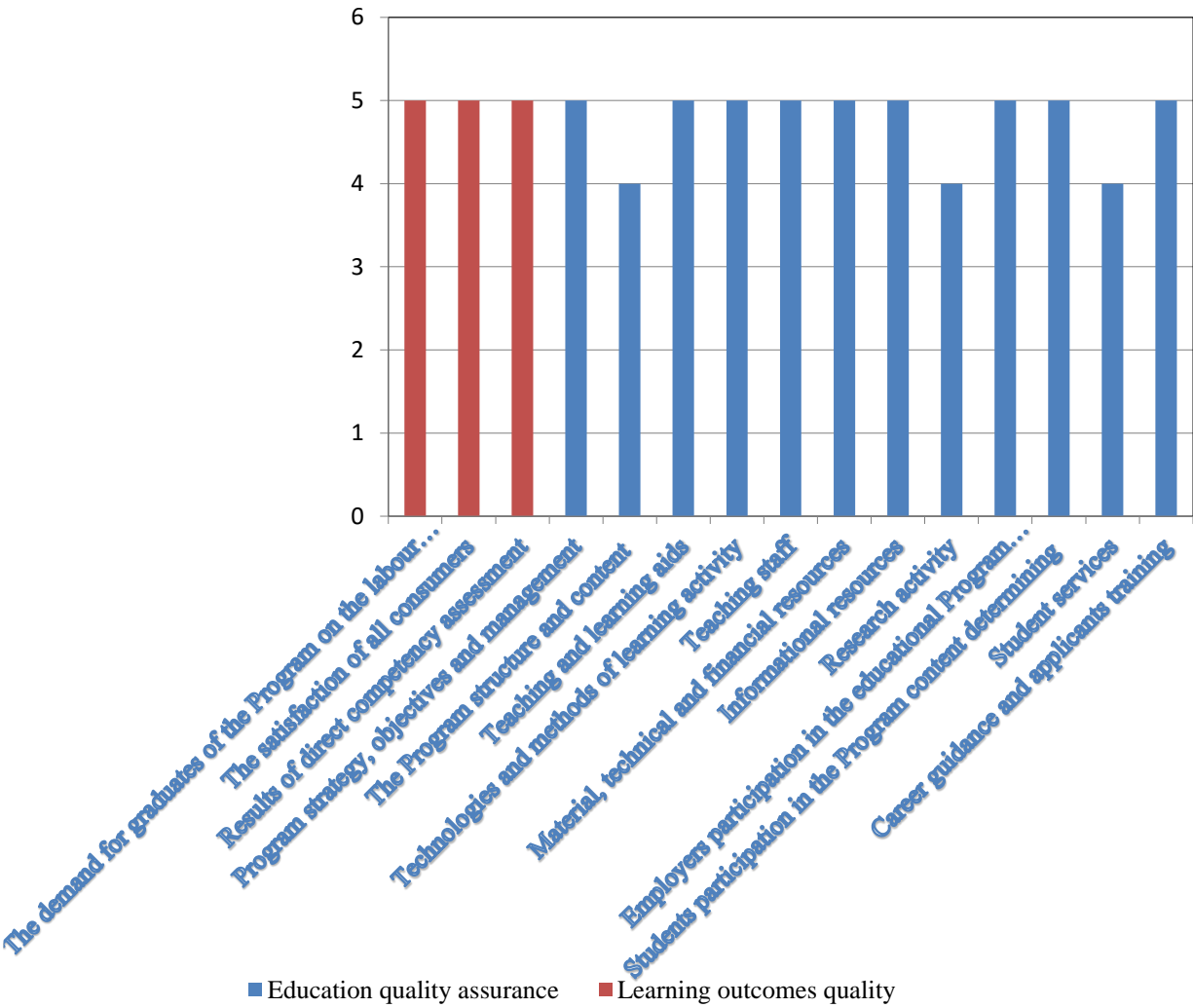
director of Chelenergopribor, doctor of technical sciences, professor G. Volovich), including interactive forms such as role-playing educational games, debates, etc.

- an increase in the activity of the EP lecturers in publishing the results of teaching activities in the form of textbooks, teaching aids, etc.
- involvement of students in the formation and development of teaching aids of the program, including the development of case studies;
- to strengthen the work of Masters involvement in mastering of various additional programs and courses, paying particular attention to language training (foreign languages);
- increasing the information transparency of the EP by publishing on the pages of the University website (web page of the Chair) of current versions of the EP, including a teaching and learning materials set;
- Given the orientation of the University to the region and the relative remoteness of the University, it is necessary to develop a system of distance career guidance and attract applicants through the organization on the university's portal (Chair's one), in social networks, on YouTube, of video workshops and special courses in the framework of the EP conducted by prominent scientists, representatives of employers involved in the educational process.

*Assessment of learning outcomes and education quality assurance*

№	Criterion	Assessment	
<i>I</i>	<i>Learning outcomes quality</i>		
	1.	The demand for graduates of the Program on the labour market	5
	2.	The satisfaction of all consumers	5
	3.	Results of direct competency assessment	5
<i>II</i>	<i>Education quality assurance:</i>		
	1.	Program strategy, objectives and management	5
	2.	The Program structure and content	4
	3.	Teaching and learning aids	5
	4.	Technologies and methods of learning activity	5
	5.	Teaching staff	5
	6.	Material, technical and financial resources	5
	7.	Informational resources	5
	8.	Research activity	4
	9.	Employers participation in the educational Program implementation	5
	10.	Students participation in the Program content determining	5
	11.	Student services	4
12.	Career guidance and applicants training	5	

**ASSESSMENT OF LEARNING OUTCOMES AND EDUCATION QUALITY ASSURANCE**





## ***QUALITY OF LEARNING OUTCOMES***

### ***1. Demand for graduates of the program on federal and regional labour markets***

***Criterion grade:*** excellent

#### ***Analysis of the role and place of the Program***

There are production facilities, enterprises of national importance in Chelyabinsk and the region. According to the official website of the Main Directorate for Labor and Employment of the Chelyabinsk Region, there is a shortage of specialists in industrial worker jobs. Experts also note that most large industrial enterprises have long experienced a lack of engineering personnel, and although the crisis negatively affects the growth of production and the pace of construction, soon the need for qualified engineers will increase.

The highest salaries of representatives of such specialties in Chelyabinsk are (according to the portal [https://stats.hh.ru/ural\\_federal\\_district](https://stats.hh.ru/ural_federal_district)): NAKS welder - 90 thousand rubles; driver of category E - 80 thousand rubles; leading programmer - 75 thousand rubles; Head of department or branch - 70 thousand rubles; ACS engineer - 62 thousand rubles; taxi driver - 60 thousand rubles; application developer - 55 thousand rubles; truck driver - 53 thousand rubles; Turner 4th category - 50 thousand rubles. Salary in Chelyabinsk depends on many criteria: position held, qualifications, experience, quality of work, workload, list of duties. Large companies are ready to invest money and time in training young professionals. They recruit candidates without experience, students and graduates, organize courses and internships for them and then provide jobs.

Key Russian partners of the university and the EP Instrument-Engineering: *in the field of space*: State Corporation Roscosmos, State Space Research and Production Center named after M. Khrunichev, State Rocket Center named after V. Makeev; *in the field of electronics*: Holding Roselektronika, Industrial Group Metran, NPO Elektromashina; *in the field of mechanical engineering*: Scientific and Production Corporation Uralvagonzavod, Kamaz, Chelyabinsk Tractor Plant, Chelyabinsk Mechanical Plant, Turbina, Zlatoust Engineering Plant, Uraltransmash, Plant UralAZ, Industrial Group CONAR; *in the field of the nuclear industry*: State Atomic Energy Corporation Rosatom, Mayak Production Association, Russian Federal Nuclear Center - All-Russian Scientific Research Institute of Technical Physics named after E. Zababakhin, Federal State Unitary Enterprise instrument-making Plant in Trehgorny city); *in the field of metallurgy*: ChTPZ Group, Chelyabinsk Metallurgical Plant, Chelyabinsk Electrometallurgical Plant.

The need of the region for graduates of the training field Instrument-Engineering is due to the following main enterprises providing employment bases for graduates: Chelyabinsk Tube Rolling Plant, Metran Industrial Group, Zlatoust Machine-Building Plant, Elektromashina NPO, Chelyabinsk Electrometallurgical

Plant, Federal State Unitary Enterprise instrument-making Plant in Trekhgorny city, Chelyabinsk Metallurgical Plant, Federal State Unitary Enterprise State Research Center named after Makeev Miass, All-Russian Scientific Research Institute of Technical Physics named after E. Zababakhin, Chelyabinsk Tractor Plant-Uraltrac, Kopeisk Machine-Building Plant Kopeisk, Turbina.

The strategic partner of the Program Instrument Engineering is the Industrial Group Metran (Chelyabinsk). Today, the Metran Industrial Group is one of the leading Russian instrument-making enterprises, from the production lines of which emerge instruments for measuring pressure, temperature, level, flow; distributed control systems, valves and regulators, metrological equipment. Metran provides all stages of the product life cycle: development, manufacturing, technical support, sales, after-sales service and customer training. This is a key Emerson asset not only in Russia but also in the CIS. The main step in the localization strategy, consistently implemented by the company for 10 years, was the opening in 2015 of a new office and production complex in Chelyabinsk with an area of almost 30 thousand square meters. The expansion of production in Russia allows us to produce world-class products under the sign "Made in Russia". Metran is a division of Emerson Corporation (NYSE: EMR), St. Louis, Missouri, USA. Emerson is a global company combining technology and engineering to create innovative solutions for customers in the industrial market, the commercial market and the individual consumer market. The Corporation has been cooperating with the University for more than 10 years. The result of the collaboration were dozens of grants received by students, postgraduate students and university professors, 2 research laboratories were created.

An analysis of the educational policy of the regional government allows us to conclude that South Ural State University is the only University in the region that has been implementing the field of training Instrument Engineering since 1999.

According to the data of the site [www.edu.ru](http://www.edu.ru) the regional map of 12.04.01 fields currently has 42 Universities in 27 regions: Altai Territory (2), Vladimir Region (2), Irkutsk Region (1), Kaluga Region (1), Krasnoyarsk Territory (1), Moscow (5), Moscow Region (1), Nizhny Novgorod Region (1), Novosibirsk Region (1), Omsk Region (1), Penza Region (1), Primorsky Territory (1), Republic of Bashkortostan (1), Republic of Karelia (1), Republic of Tatarstan (Tatarstan) (2), Rostov Region (3), Ryazan Region (1), Samara Region (1), St. Petersburg (7), Saratov region (1), Sverdlovsk region (1), Sevastopol (1), Tomsk region (1), Tula region (1), Udmurt Republic (1), Ulyanovsk region (1), Chelyabinsk region (1)).

### *Analysis of information indicators presented by the University (conclusions)*

The high grade of the criterion "Demand for the Program graduates on the federal and regional labour markets" is confirmed by the following factors:

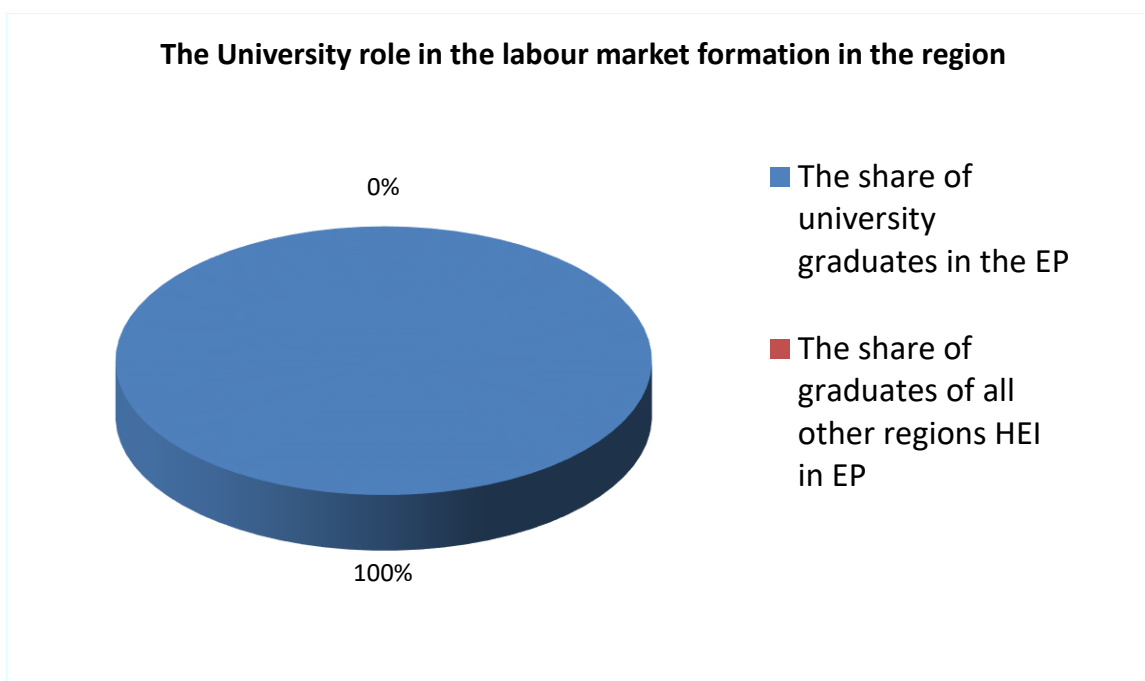
- One hundred percent indicator of the graduates contingent employed in the region within one year after graduation in the training field, combined with the fact

that most motivated students combine university studies with work in the specialty profile;

- Lack of complaints on graduates;
- The presence of positive feedback from organizations about the work of graduates, including in the process of interviewing employers during the site visit as part of the evaluation of the EP;
- High competition level (up to 3 people per place) for graduates of the Bachelor program enrolling to studies in the Master's educational program.

### **Additional material**

According to the results of a self-evaluation conducted by the educational organization, data on the graduates work placement are presented. The data provided by the EI were confirmed while examining the relevant documents. A chart confirming the crucial role of the University in shaping the labour market in the region is given below.



## **2. Satisfaction with learning outcomes**

**Criterion grade:** excellent

- The share of employers who believe that the competencies of graduates of the Program:
  - fully meet the requirements for up to date industry specialists - 20%;
  - broadly consistent with modern requirements for specialists in this industry, but there are minor comments- 80%;
  - few graduates whose competencies correspond to up to date requirements for specialists in this industry - 0%;

- do not meet the requirements for specialists in this industry- 0%.
- The share of graduates satisfied with the learning outcomes:
  - fully satisfied - 25%;
  - mostly satisfied -58.3%;
  - more dissatisfied - 16.7%;
  - unsatisfied- 0%.
- The share of graduates satisfied with career development:
  - fully satisfied – 58.3%;
  - mostly satisfied -41.7%;
  - more dissatisfied - 0%;
  - unsatisfied- 0%.
- The practice of questioning employers (including enterprises that provide the bases for pre-graduation practice) on the completeness of competencies formation among graduates of the Program.

### **3. *Direct competency assessment by experts***

***Criterion grade:*** excellent

During the site visit, the reviewers conducted a direct assessment of the competencies of students of the graduation course. Ten 2-year students took part in the direct assessment, which is 53% of the final course.

During the direct assessment procedure, testing and assessment materials developed by the educational organization were used, as these materials were recognized by experts as valid, and testing and assessment materials prepared by experts were also used. To analyze the development of competencies the expert chose the following ones:

- Assessment of competencies that characterize the personality and that are an integral part of his / her professional competency:

ability to abstract thinking, generalization, analysis, systematization and forecasting (GC-1);

ability to self-development, self-realization, use of creative potential (GC-3);

- Direct assessment of social competencies aimed at the development, maintenance and improvement of communication

the ability to use a foreign language in the professional field (GPC-3);

- Direct assessment of professional competencies ("core competencies") including competencies which reflect the demand (needs) of the federal and/or regional labour markets depending on the major employers of the graduates of the program

the ability to design mathematical models of objects of study and the choice of a numerical method for their modeling, the development of a new one or the choice of a ready-made algorithm for solving the problem (PC-1);

the ability to design, develop and implement technological processes and production modes, quality control of devices, systems and their elements (PC-10)

ability to manage installation, commissioning (adjustment), testing and completion of prototypes of devices and systems (PC-13);

ability to develop and optimize programs of the model and full-scale experimental research of devices and systems (PC-15).

In the process of direct competency assessment, the reviewers used the following testing and assessment materials: electronic tests and questions to assess the respective competencies in the disciplines of "Project Management", "Mathematical Modeling in Instrument Systems", "Neural Network Technologies", "Distributed Intelligent Automated Control Systems for Technological Processors", "Wireless technology for the transfer of measurement information and data". For example:

1. Under the adequacy of the model is understood: the accuracy of the forecast according to the behavior model of a real system, expressed in quantitative terms; established limits for changing the values of variables, as well as limiting conditions for the distribution or expenditure of any resources; ease of use of the model;
2. From the list below, select a software package designed to solve technical computing problems: Mentor Graphics PADS; MathWorks MATLAB; Dassault Systèmes CATIA;
3. The approximation problem is: to find a solution that satisfies the constraint system and maximizes or minimizes the objective function; in indicating the membership of the input image represented by the feature vector to one or more predefined classes; in finding estimates of the unknown function  $F(x)$ ;
4. Artificial neural networks classification. The basic schemes of neural networks. Description of the elementary perceptron, algorithms for its training. Features and limitations of the model.
5. Conversation on the topic of the graduate qualification work of each student: the formulation (including in English) of the name, relevance of the work, its purpose and objectives. Analysis and presentation of ways to solve them in the framework of the Master's work of a student. Prospects for the practical application of the results in production.

Based on the results of a direct assessment of competencies, the reviewers revealed that 80% of the students coped with 80-100%, and 20% of the students coped with 79-50% of the tasks.

Level	Sufficient level (have managed to solve	Acceptable level (the percentage of solved	Low level (percentage of solved
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Students ratio	80% of the proposed tasks)	tasks from 50 to 79%)	tasks is less than or equal to 49%)
The results of direct assessment of competency that characterize the personality and that are an integral part of his/her professional competence			
90%	+		
10%		+	
The results of direct assessment of social competencies aimed at the development, maintenance and improvement of communication			
80%	+		
20%		+	
The results of direct assessment of professional competencies ("core competencies ") including competencies which reflect the demand (needs) of the federal and/or regional labour markets depending on the major employers of the graduates of the program			
80%	+		
20%		+	

During the assessment of the education quality, the reviewers got acquainted with 5 GQWs, which amounted to 31 % of the graduate qualification works of last year in this field. The reviewers concluded that considered GQWs complied with all the requirements stated below:

### GRADUATE QUALIFICATION WORKS

№	Objects of evaluation	Experts Comments
1.	The topic of GQW corresponds to the field of degree and the current level of development of science, equipment and (or) technology in the field of the program.	in compliance
2.	The tasks and content of the GQW are aimed at confirming the formation of the graduate competencies.	in compliance
3.	The degree of use of the materials collected or received during the pre-graduation practical training and the preparation of term papers in the independent research units of the GQW.	mostly consistent (not all TP results were used in GQW)
4.	The topic of GQW is defined by the requests of the industry organizations and the tasks of the experimental activity solved by the teachers of EI.	in compliance
5.	The GQWs results find practical application in industry.	consistent, confirmed by enterprises reviews
6.	The degree of use of the results of the R&D of the Chair, faculty and third-party research and production and/or research organizations in the implementation of independent research parts of the GQW.	R&D results share using in GQW not specified

### *Reviewers' conclusions and recommendations*

#### **Conclusions**

According to the results of the analysis of the level of student learning outcomes quality, it can be concluded that the quality of graduate training is quite high, which is confirmed by quantitative assessments for all quality assessment criteria:

- the demand for graduates of the program on the labour market - excellent,
- the satisfaction of all consumers - excellent,
- direct assessment results - excellent.

- One hundred percent indicator of the graduates contingent employed in the region within one year after graduation in the training field, combined with the fact that most motivated students combine university studies with work in the specialty profile;

- High competition level (up to 3 people per place) for graduates of the Bachelor's program enrolling to studies in the master's education program.

- Lack of complaints on graduates;

- According to the results of an enterprises survey provided by the University, none of the employers surveyed rated the competencies of graduates as not meeting the requirements put forward by them for Masters in instrumentation, which, together with the results of the interview with representatives of employers during the site visit, point to a rather high degree of satisfaction of employers with the quality of graduates training in the educational program "Instrument Engineering";

- The results of a direct assessment of competencies showed that 100% of students had a sufficient and acceptable level of knowledge, of which 80% of students coped with 100-80%, and 20% of students coped with 79-50% of assessment tasks: competencies characterizing a person's personal qualities, being an integral part of one's professional competence; competencies aimed at the development, maintenance and improvement of communications; professional competencies ("core competencies"), including competencies that reflect the requirements of the regional and federal labor market.

#### **Recommendations**

- The identification of the degree of use of the results of the R&D of the Chair, faculty and third-party research and production and/or research organizations in the implementation of independent research parts of the GQW.(Explanation: one of the criteria for assessing GQW within the framework of public-professional accreditation of EP and one of the objects of assessment is the degree of use of the results of the R&D of the Chair, faculty and third-party research and production and/or research organizations in the implementation of

independent research parts of the GQW. It would be useful to show this degree, for example, on the title page of the GQW.)



## QUALITY ASSURANCE OF EDUCATION

### *1. Strategy, objectives and program management. Internal quality assurance system*

**Criterion grade:** excellent

#### ***Strengths of the Program***

- the content of the program is based on the analysis and forecasting of the needs of the regional labour market for specialists in the training field Instrument Engineering, taking into account the specific requirements of the largest enterprises, including the strategic partner Metran Industrial Group JSC (Chelyabinsk), which is Emerson asset in Russia;
- the Program Head and the Chair's administration, implementing the EP, analyze the program, identify its strengths, determine the program development path.

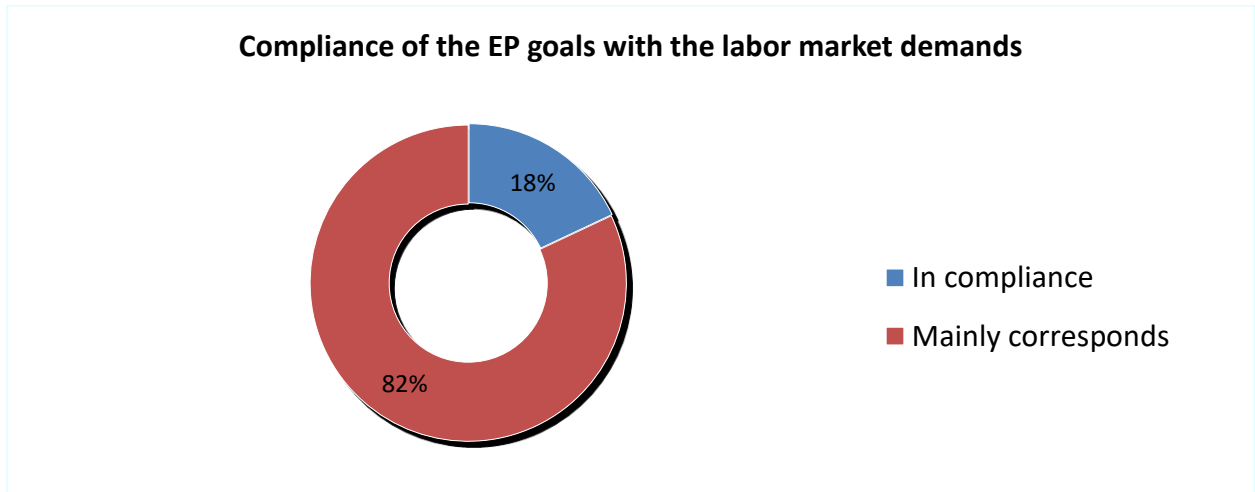
#### **Recommendations**

- regulated management procedures development and monitoring of the EP implementation and its annual updating to the requirements of current regulatory legal acts and standards with special attention to organizing and guaranteeing the possibility for students to choose disciplines within the variable part of the educational program;
- informing students of the program in the training field Instrument Engineering about the educational program objectives and information sources on it (organizing the placement of relevant EP data on available resources, including updated syllabi, FSES and TLA kits in accordance with the current Federal State HE requirements) ;
- stimulation of the teaching staff to practical work on the profile of the taught disciplines (possibly in the framework of the development of the University's system of key performance indicators (KPI));
- at the system level, develop and implement procedures for involving students in the processes of improving the quality and quality assurance of education, bringing information about management decisions made to improve educational programs to all interested parties, including students (as well as developing at the faculty (in the Dean's office) a documented system of consideration of student appeals and complaints; feedback system based on the results of students' assessment of the taught disciplines received in the frame of the implementation of the Regulation on the regular mandatory assessment by students of the quality of the implementation of academic disciplines and the work of teachers, approved by order of the Rector dated 11/02/2017 No. 405);
- intensification of the activities of the program management on the conclusion of training agreements at the expense of legal entities (including targeted training agreements).

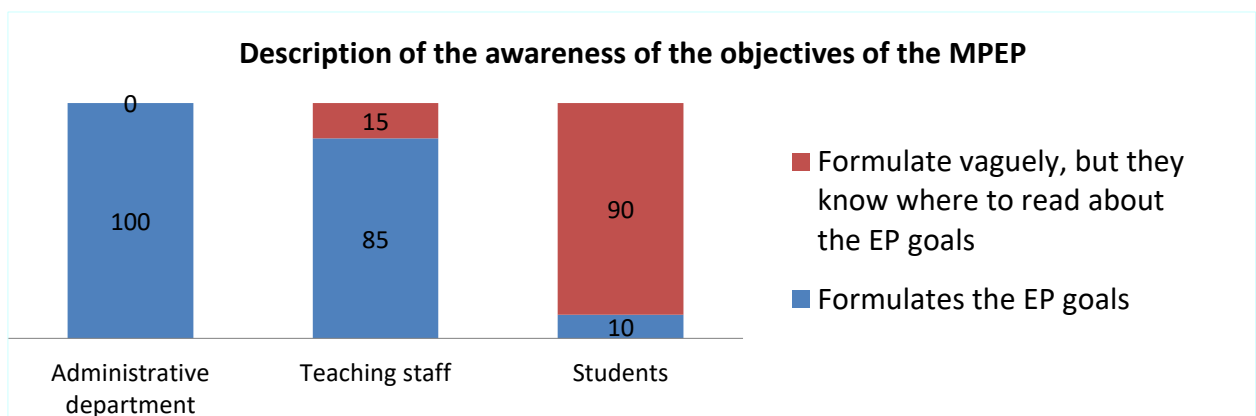
### Additional material

During the site visit, an interview with employers has been held, based on the results of which a diagram was compiled.

The data presented in the diagram allow the experts to conclude that the objectives of the educational program correspond to the demands of the labour market.

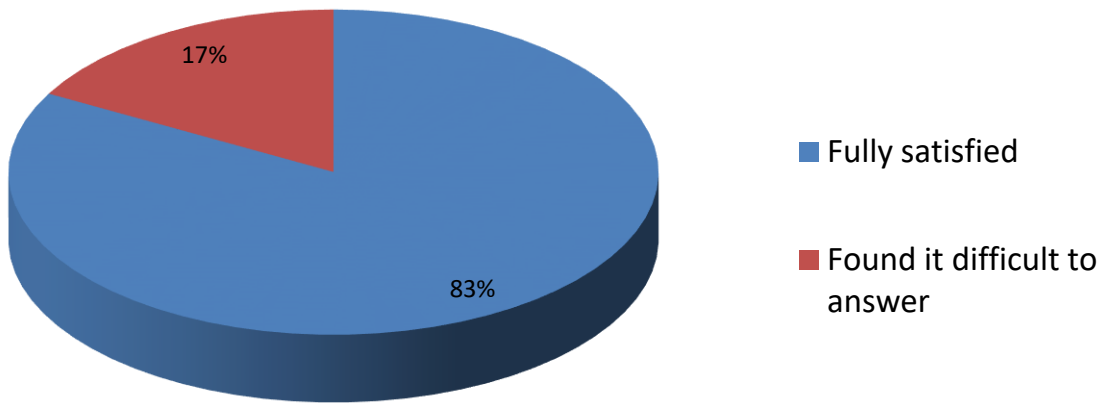


During the site visit, the experts interviewed students, professors, employees and received data that allowed the experts to conclude that the main part of the administration and teachers could formulate the goals of the EP, unlike students who mostly couldn't, but they knew where to find this information.

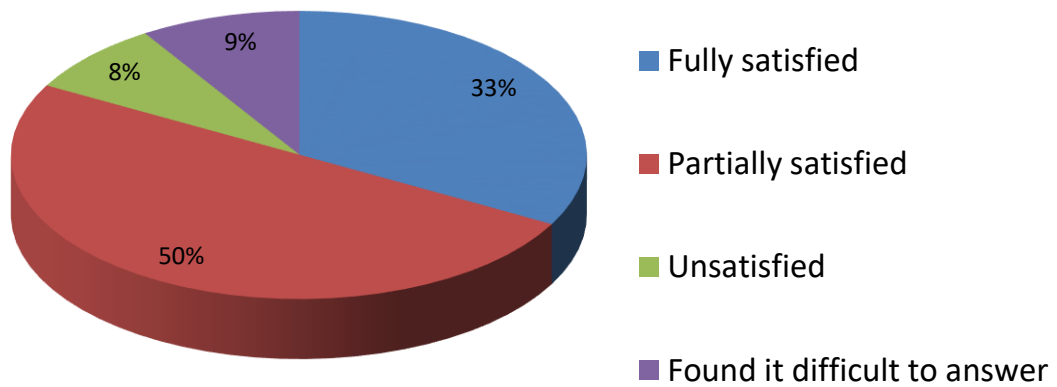


Based on the results of the self-evaluation by the educational institution, data were presented on teaching staff's satisfaction with the personnel policy and the current motivation system.

**Satisfaction with personnel policy**

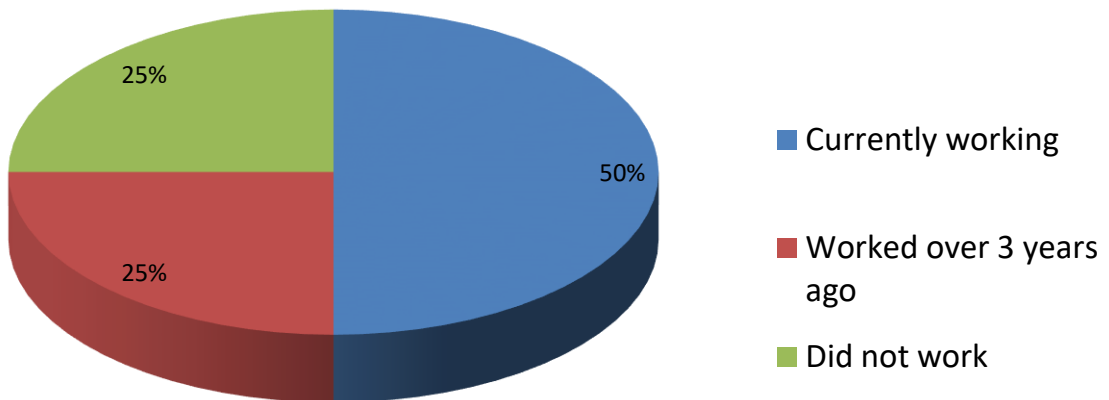


**Satisfaction with the current motivation system**



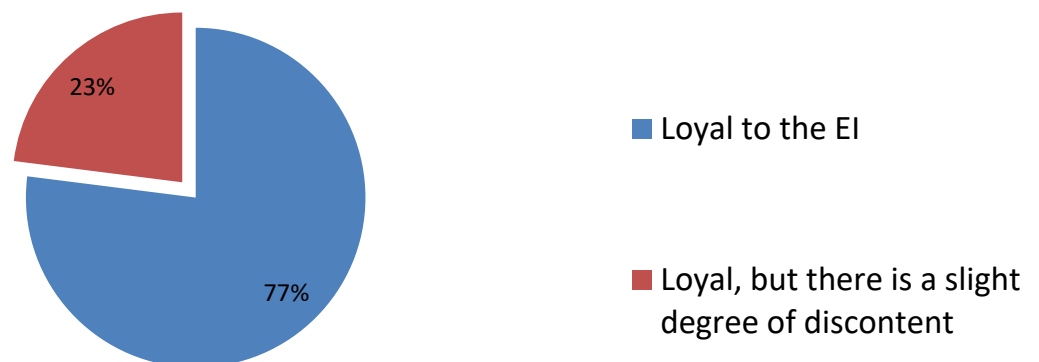
Based on the results of the self-evaluation by the educational institution, data were presented on the availability of practical experience in the profile of the taught discipline.

### Practical experience in the profile of the taught discipline



During the site visit, interviews were held with teachers involved in the implementation of the program. The interview results combined with the data presented in the self-evaluation report are presented in the diagram “Employee Loyalty Level”.

### Employee loyalty level



Based on the analysis of these diagrams, the expert concludes that more than 70% of the faculty is loyal to the EI, but only about 17% are completely satisfied with the personnel policy and 33% of the teachers are completely satisfied with the motivation system in the EI, which makes it necessary to identify and eliminate the reasons for the decrease in loyalty to EI. At the same time, it also seems necessary to stimulate the teaching staff to the practice in the profile of the subjects taught and, as a result, to increase the percentage of teachers with practical experience (according to the survey, 25% of teachers do not have such experience), and according to the self-evaluation report, to implement the professional disciplines of the educational Program, 10 people were involved in, 3 of them (30%) have

experience in the profile of the discipline being implemented (paragraph 19, criterion 5 self-evaluation report).

## **2. *Structure and content of the program***

**Criterion grade:** good

### **Strengths of the Program**

- students involvement in research work, starting from the first year;
- introduction of the results of scientific works and master classes conducted by representatives of enterprises (employers) into the educational process;
- development of material and technical base
- development of information resources (including electronic information environment).

The effectiveness of the implementation of the educational program is assessed by the results of intermediate and final examination of students; as well as by the conclusion of the state examination commission; by the students' achievements in research; as well as by the employment of graduates in industries related to the creation of modern high-tech electronic tools; career and scientific growth of graduates.

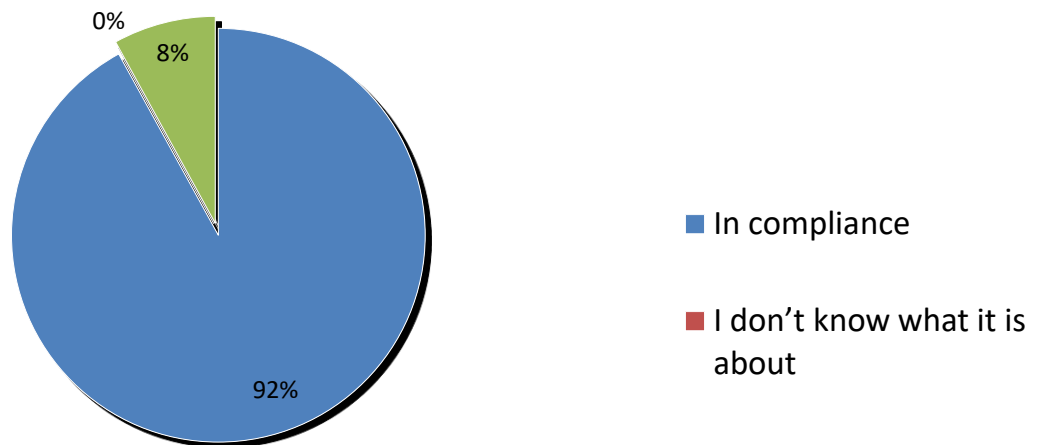
### **Recommendations**

- development of regulations for the active participation of students in the process of forming the curriculum (structure and content) within the framework of elective disciplines (in conjunction with monitoring of the implementation of the Regulation on the procedure for students to choose academic disciplines when mastering the basic educational programs of higher education, approved by order of the South Ural State University Rector of 03/24/2015 No. 85) in order to ensure greater flexibility and adaptability in the training process management in accordance with professional interests, formed by the results of training, practical training during the study period at the Bachelor's degree and in the first year of Master's and work experience in the specialty, as well as with the aim of expanding the possibilities of planning various educational paths leading to the provision of the seventh (and later, if desired, higher) qualifications level of graduates and their career growth;
- updating the EP under the requirements of the FSES HE (3++) to teach students of the 2019 year admission with regard to the requirements of professional standards (in accordance with clause 3.1 of section III and clause 4.2 of section IV of the Rules of development, approval and update of educational program HE approved by order of the Rector of 09/02/2015 No. 268).

### Additional material

During the site visit, the reviewers met with students of the Program evaluated. One of the issues discussed was the correspondence of the structure and content of the program to the expectations of the direct consumers of the Program (students).

**Correspondence of the structure and content of the EP to students' expectations**



The data collected from the interviews are presented in the diagram. And they allow the reviewers to conclude that the students (more than 90% of respondents) confirm that the structure and content of the educational program meet their expectations.

### 3. *Teaching and learning aids (TLA)*

**Criterion grade:** excellent

#### **Strengths of the Program**

- The EI has developed the Rules for the development, approval and update of the EP (approved by the order of the Rector of 09/02/2015 No. 268), which describe the interaction of various structural units and Chairs (graduating Chair, Teaching and Learning department, scientific and learning council of the field training "Instrument Engineering" and the Academic Council of the University) in the development and implementation of educational disciplines TLA;

- syllabi of disciplines necessarily undergo the procedure of coordination with key partners representing the labour market, as they are the main component of the EP, which is developed and coordinated by representatives of employers. Thus, 100% of the syllabi of disciplines (modules) and practices are agreed with key partners;

- programs of general professional and special disciplines (disciplines of a professional cycle) of the EP "Instrument-Engineering" include modern achievements of science, technology, and management, including production in the field of training. For example, teaching materials of the discipline "Assessment in measuring systems" include the study of inertial sensors, elements of robotic systems; estimation of systematic error of digital devices. Laboratory work in the discipline "Distributed Intelligent Automated Control Systems for Technological Processes" is carried out in a laboratory of measuring-controlled systems based on the distributed intelligence architecture PlantWeb 2.0 (Competency Center of Emerson International Corporation - Metran Industrial Group).

### **Recommendations**

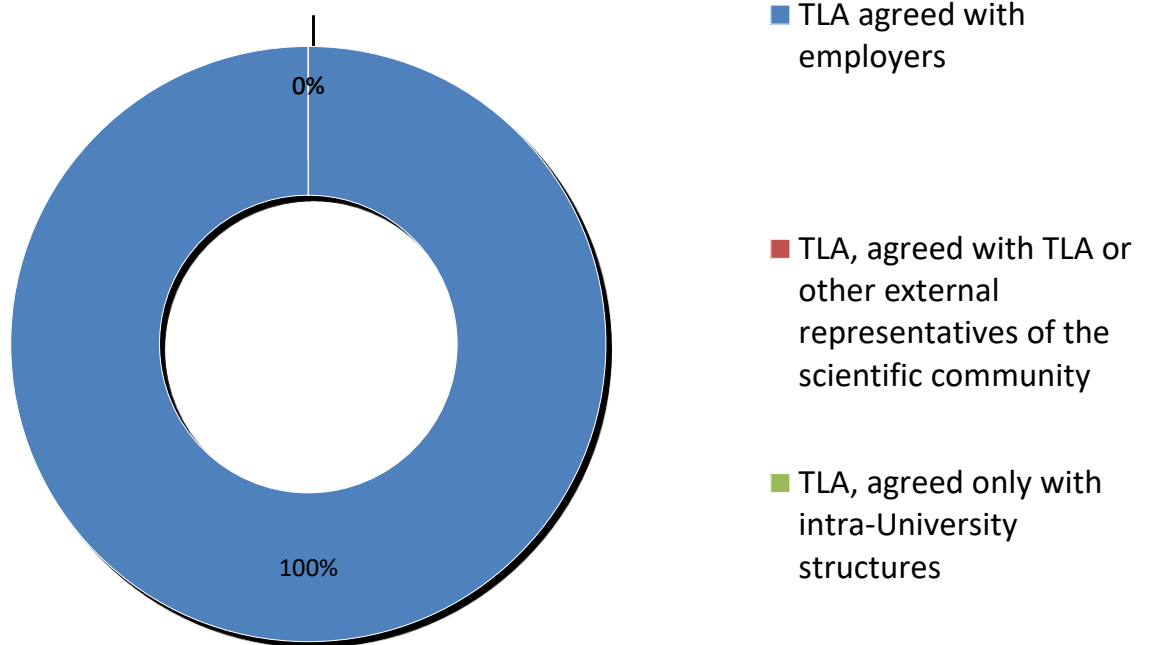
- increase the completeness of the annual updating of the TL complex of disciplines (in the paradigm of competency approach), taking into account the requirements of the FSES HE (3++) and professional standards;
- increase the information transparency of the main educational program "Instrument-Engineering" by publishing on the University website pages the current versions of the syllabi of the disciplines and other elements of the TL complex, updated to meet the requirements of the current regulatory framework;
- development of mechanisms for attracting students to the updating of TLA, in particular, by conducting anonymous surveys on proposals for the development and/or updating of existing TLA (lecture notes, textbooks, teaching guidelines, etc.), joint development of relevant case-tasks(with the teacher).

### **Additional material**

During the site visit, the reviewers got acquainted with the teaching materials developed at the educational institution. Based on the results of a study of 25% of the TL complexes of the disciplines of the curriculum, the following diagram was compiled.

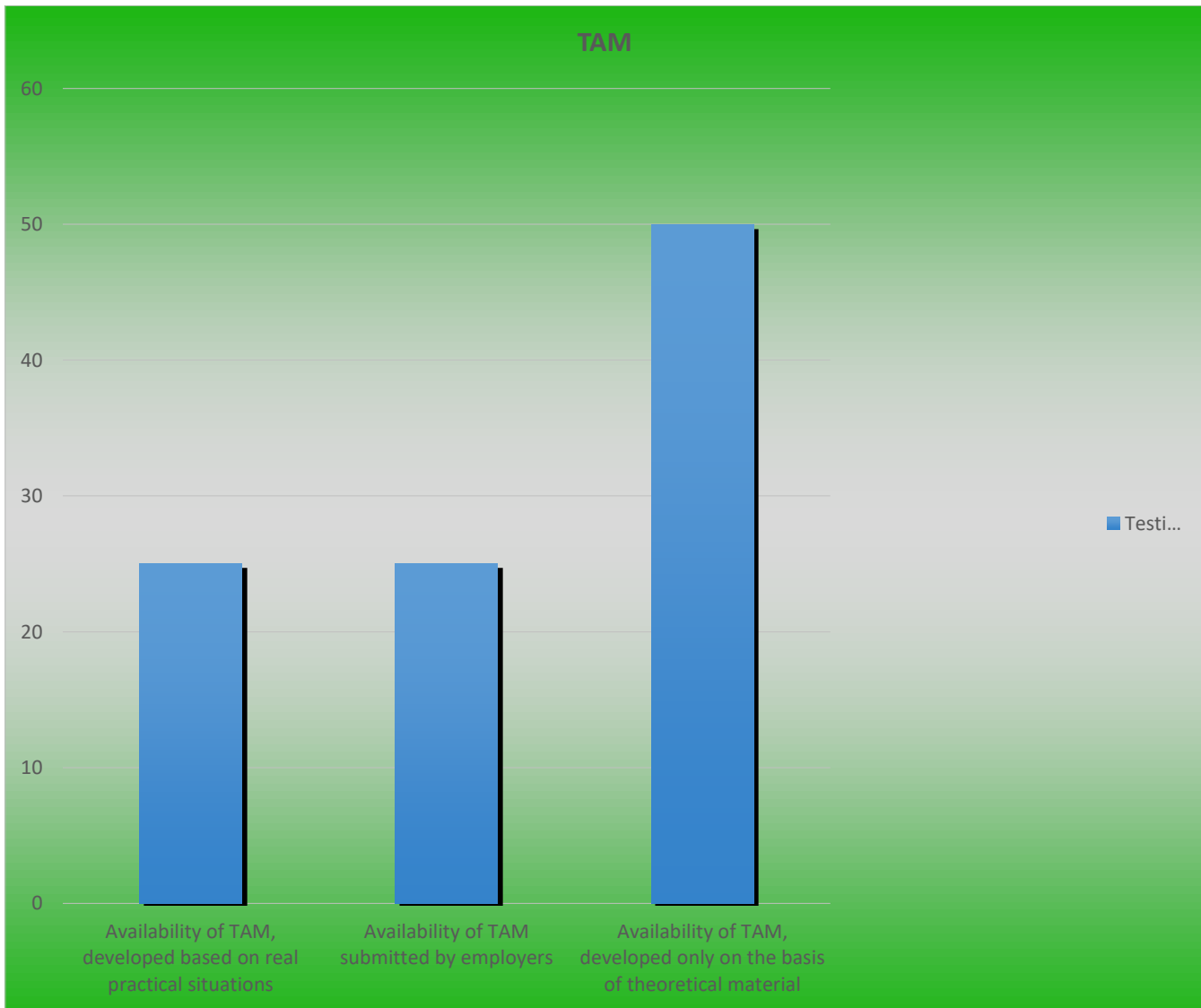
These data allow the reviewers to conclude that 100% of the TM are agreed with employers.

## TLA



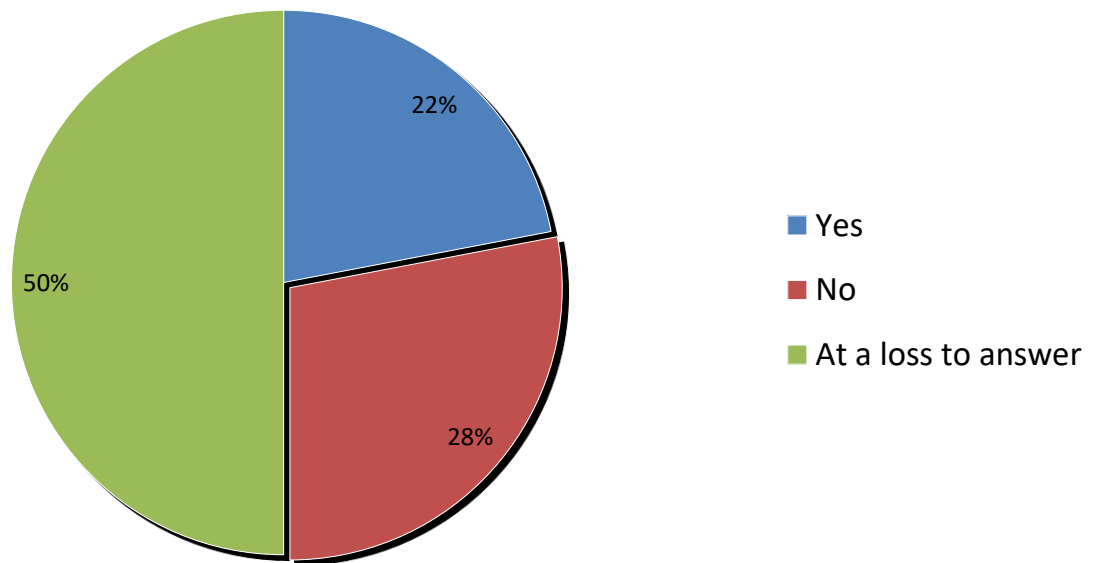
During the site visit, the reviewers analyzed the testing and assessment materials that are used by the educational institution for the ongoing monitoring of academic performance. The data on the results of the analysis of testing and assessment materials confirmed the data given in clause 7 of criterion 3 of the self-evaluation report and are presented in the following diagram. This allowed the reviewers to conclude that testing materials developed on the basis of theoretical material predominated.





According to the results of the questionnaire presented by the educational institution, and during the site visit, it was found that only about 20% of students believed that their opinion was taken into account when developing and updating TLA.

## Consideration of students' opinions when developing and updating the TLA



Under the results obtained, the reviewers recommend that the educational organization develop mechanisms to attract students to the development and updating of teaching and learning aids and revise the percentage ratio of sources for the formation of testing and assessment materials of TLA.

### 4. *Technologies and methods of learning activity*

*Criterion grade:* excellent

#### **Strengths of the program**

- introduction of the “Barrier-free environment” system, the main purpose of which is the creation of conditions for providing inclusive education for people with disabilities in higher education programs, pre-university training and career guidance for disabled students, support for inclusive education of students with disabilities, addressing development issues and servicing the information technology base of inclusive education, distance learning programs for people with disabilities, sociocultural rehabilitation, promoting the employment of disabled graduates, creating a barrier-free architectural environment;
- ensuring the intensification of the educational process and, as a result, the activation of cognitive activity of students through regular monitoring of knowledge; current control (tests, homework) during the semester; final control at the end of the discipline and the formation of a cumulative resulting assessment of the final control based on the assessments of current control; through focusing on the independent work of students;
- the use of a point-rating system for assessing the results of educational activities of students (the position was approved by order of the Rector No. 179 of

May 24, 2019), which is aimed, inter alia, at individualizing the educational process, organizing and stimulating students' independent work; widespread use of new teaching aids in the educational process; development of competitiveness among students in the educational process; increasing student learning motivation; providing an objective assessment of the level of knowledge and skills of students and competencies of graduates;

- maintenance of innovative modern methods of learning activity by the electronic information and educational environment of the University, which includes the University's Internet portal, the University's Electronic Library System (ELS), KIAS "Univeris", the distance learning system "Electronic SUSU": <https://edu.susu.ru/>.

### **Recommendations**

- the introduction of new educational technologies recommended by the EP reviewer into the educational process (see page 2 Reviews for the EP Instrument Engineering, signed by the director of Chelenergopribor, Doctor of Technical Sciences, Professor G. Volovich), including interactive forms such as role-playing educational games, debates, etc.

### **Additional material**

During the site visit, the reviewers attended a lesson, an analysis of which is presented below.

Name of the lecturer: E. Yurasova

Group/specialty: KE -125,131

1. Discipline/module: Wireless technology for the transfer of measurement information and data
2. Type of training session  
laboratory work
3. The theme of the lesson: Administration of managed switches: Network management using SNMP. Managed Switch Administration: Configuring Ports and Working with the Switching Table.
4. Purpose of the lesson: Acquisition of practical skills in administering managed switches.
5. Objectives of the lesson: Acquisition of practical skills in administering managed switches: Network management using SNMP. Managed Switch Administration: Configuring Ports and Working with the Switching Table.
6. Material and technical support for the lesson: laboratory equipment for conducting laboratory classes in the discipline Wireless technologies for transmitting measurement information and data (specialized laboratory "Technologies and means for transmitting measurement information").
7. Please List:

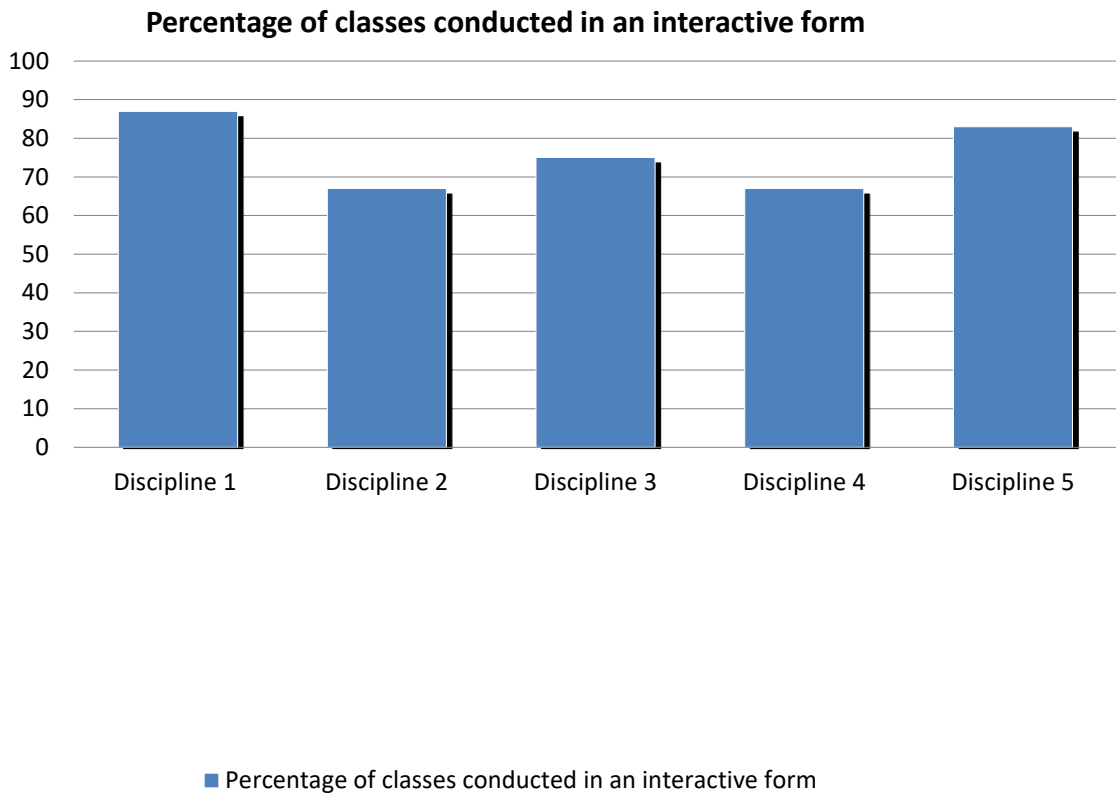
No.	KSs that are planned to be formed in the lesson and competencies, the formation of which is affected by these KSs (should be voiced by the lesson's teacher)	Forms, tools, methods and techniques that are planned to be used in the lesson to form the competency
	KSs within the competency PC-13: the ability to manage installation, commissioning (adjustment), testing and commissioning of prototypes of devices and systems	Teamwork with a clear separation of responsibilities for laboratory work. Formation of a report on the work and further individual defense by each student of the laboratory work.

### THE EVALUATION OF THE TEACHER

No	Analysis criteria	Indicator	Grade (0,1,2)
1.	Compliance with training session regulations	A timely beginning and ending of the lesson, time-balanced sections.	2
2.	Organizational process	Greeting. Communication of the topic, objective (the connection of the objectives to the competencies formed).	2
3.	Motivation of students for the upcoming activities	Indication on formation of the modern professional and / or social and personal competencies.	2
4.	Classroom climate	The presence of a positive emotional interaction between the teacher and the students; mutual goodwill and audience participation.	2
5.	The quality of presentation	Structuredness of the material; clarity of current tasks; consistency and comprehensibility of presentation; adaptation of the presentation to the specificity of the audience; availability of examples and relevant facts.	2
6.	Compliance of the content with the program course	To compare with the TLA.	2
7.	The usage of visual materials	Textbook, practical training, hand-outs, tables, illustrations, etc.	2
8.	Declamatory skills	Audibility, intelligibility, euphony, literacy, speech tempo; facial expressions, gestures, pantomime; emotional intensity of the performance.	2
9.	Sensitivity to the audience	The ability to react to the changes in the perception of the audience.	2
10.	Ethics		2

11.	Methods of attention organization and student behaviour regulation	Increase of interest among the audience (interesting examples, humour, rhetorical devices, etc.); involvement of the audience into a dialogue, in the process of tasks performance, etc. But it is unacceptable: to call upon the attention of the audience in an open form; to demonstrate disapproval; to use methods of psychological pressure, or blackmailing.	2
12.	Maintaining the “feedback” with the audience in the course of the training session	Control of material understanding.	2
13.	Summing up of the lesson (organisation of reflection)	Organisation of the reflection process at the end of which all the students are actively involved in the discussion of the conclusions	2
14.	Looks	Compliance with the corporate identity, presentable appearance, charisma.	2
15.	Final evaluation		2
16.	Notes and reviewer recommendations:		

At Desk analysis of the self-evaluation report, the analysis of the curriculum and the schedule of training lessons the reviewers identified that the share of training lessons conducted in an interactive form on the program exceeds 70%. In the course of the site visit, the teaching materials of five disciplines were studied (Wireless technologies for transmitting measurement information and data (1); Information technologies in instrumentation (2); evaluation in measurement systems (3); Design and construction of measuring instruments (4); Distributed intelligent automated process control systems (5)). Data on classes conducted in an interactive form in the context of the studied teaching materials are presented below.



## 5. *Teaching staff*

**Criterion grade:** excellent

### **Strengths of the Program**

- international experience of scientific work of the teaching staff (combination by the teacher (Assoc. professor O. Yu. Bushuev) of teaching with scientific work in the international laboratory "Self-diagnostics and self-monitoring of devices and systems" under the guidance of the professor at Oxford University (Great Britain) Manus Henry);

- more than 80% of the teachers providing the educational process have Russian or foreign academic degrees and titles, while more than 20% of teachers have academic degrees of Doctor of Sciences (including PhD) or the academic title of professor;

- attraction of young professionals who have graduated from the University and have experience in the specialty at large enterprises of the city to postgraduate school for active research activities and the formation of a "Personnel reserve" with participation in various activities to ensure the successful passage of competitive procedures provided for the formation of the teaching staff of the Department.

### **Recommendations**

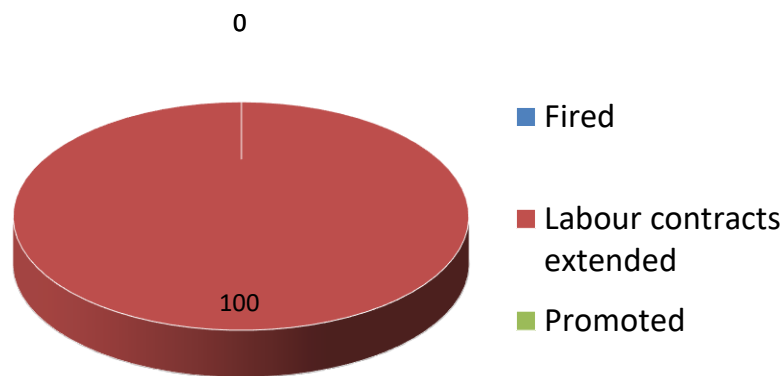
- increase in the percentage of teachers involved in the implementation of professional disciplines, combining work in the EI with professional activities in the specialty (at the moment, according to the self-evaluation report, 10 people were attracted to the implementation of professional disciplines of the educational program, of which 4 people (40%) combine work in the EI with professional activities in the specialty);

- increase in the percentage of teachers involved in the implementation of professional disciplines with experience in the profile of the implemented discipline (currently, according to the self-evaluation report, 10 people are involved in the implementation of professional disciplines of the educational program, of which only 3 people (30%) have experience of work in the profile of the implemented discipline).

**Additional material**

Analyzing the facts stated by the educational institution in the self-evaluation report, the reviewer concluded that the data presented were relevant and reliable. The results of a comprehensive assessment of the teaching staff (based on the results of last year), which takes part in the program implementation, are presented in the diagram.

**Based on the results of a comprehensive assessment of teaching staff in the framework of the EP implementation**



**6. Material, technical and financial resources of the program**

*Criterion grade:* excellent

**Strengths of the Program**

- classrooms of the educational institution are equipped with up-to-date multimedia equipment and computer equipment;

- for basic and applied scientific research implementation, the educational building is equipped with stationary computers and special software, as well as

with necessary equipment for laboratory work and practical training in the training field "Instrument-Engineering";

- classroom studies in professional disciplines are held inter alia in educational and scientific laboratories equipped with samples of serial industrial instruments and devices, which confirms and guarantees the presence of real-life practical situations in TAM and allows to evaluate the formation of professional competencies;

- students and teachers have access to electronic library resources and systems (ELS) based on direct agreements with copyright holders;

- Education is available for people with disabilities.

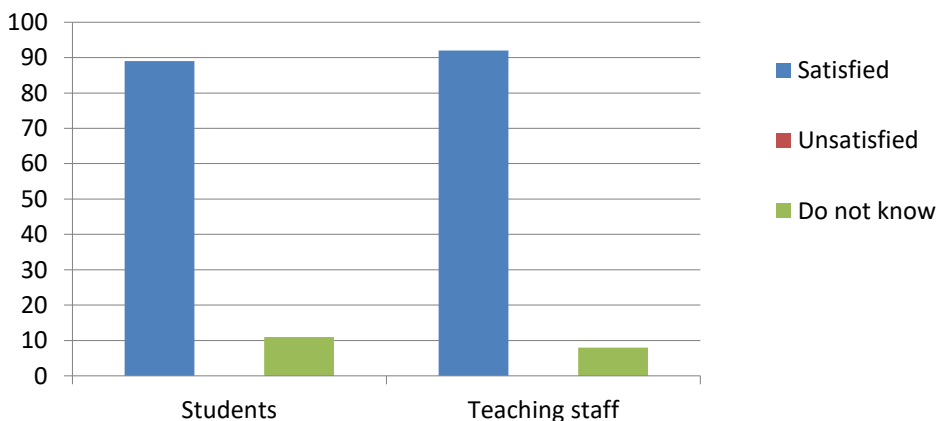
### Recommendations

- Implementation of mechanisms for additional financing of the program (entrepreneurial activity, the attraction of private investments, an increase in the proportion of students studying on a paid basis, etc.)

### Additional material

During the site visit, the reviewers interviewed students and teachers participating in the implementation of the program for satisfaction with the quality of the classroom fund. The data obtained are presented in the following diagram and allow the reviewers to conclude that the level of satisfaction of students and teachers with the material and technical base of the educational institution is quite high.

**Satisfaction with the quality of classrooms, laboratories, Chairs, funds and the reading room of the library**





During the site visit to the educational institution, the reviewers examined the material and technical base. Two scientific and educational laboratories equipped with the participation of the Metran SG:

Emerson Competency Center (Aud.437/3);

PlantWeb laboratory (452/36).

Computer class for 13 workplaces (537/3b), equipped at the expense of employers.

Laboratory of Self-diagnosis and self-monitoring of devices and systems. (Laboratory under the direction of Professor of Oxford University (Great Britain) Manus Henry).

The data presented allow one to conclude that the level of equipment of the laboratories of the EI is quite high.

## **7. Information resources**

**Criterion grade:** excellent

### **Strengths of the Program**

- the presence of the corporate information and analytical system “UNIVERIS”, in which the personal accounts of university employees (teaching staff, research fellows, etc.) and students (students, postgraduate students, etc.) with extensive functionality are available. The system is also integrated with the distance education portal Electronic SUSU, university e-mail and a Wi-Fi wireless network.

### **Recommendations**

- increase of the information transparency of the educational program “Instrument-Engineering” by publishing on the pages of the University website of the current versions of disciplines syllabi and other elements of the TL complex (at the time of the evaluation, on the Chair’s web page <https://www.susu.ru/ru/plan/120401-2018-20-priborostroenie-26490> and on the University one <https://www.susu.ru> , [https://abit.susu.ru/division/structure/program\\_detail.php?ELEMENT\\_ID = 1767 & return = ke](https://abit.susu.ru/division/structure/program_detail.php?ELEMENT_ID=1767&return=ke) there was incomplete and/or outdated information not updated as required by FSES HE 3 ++. The EP for 2019 admission year is completely absent (accessed 11/01/2019). The EP attached annotation for the 2018 admission year has inaccuracies, outdated codes of training fields);

- development of interactive electronic educational resources: multimedia textbooks, educational videos, online training courses in the disciplines of the training field "Instrument-Engineering" for the convenience of students, for an increase of interest in the disciplines, to facilitate independent work and, as a result, increase the effectiveness of training.

- placement on the web page of the Chair of scientific and educational resources (monographs, textbooks, teaching aids, articles, reports at conferences) to increase the availability of materials that allow, in particular, applicants to get a complete picture of future qualifications.

## **8. *Scientific research***

**Criterion grade:** good

### **Strengths of the Program**

- during the standard period of study in the EP “Instrument Engineering” 100% of students take part in conferences, for example: Annual student's scientific conference of SUSU; International Scientific Conference “Digital Industry: State and Development Prospects 2018”; International scientific and technical conference "Problems of receiving, processing and transmitting measurement information".

- most of the research work of students is carried out in the framework of large research projects;

- most teachers have published scientific articles and monographs, participate in national and international conferences;

- student participation in project training.

### **Recommendations**

- increase of activity of participation of students in research work, participation in competitions of grants and scientific papers, receipt of additional scholarships (President of the Russian Federation, Governor, Rector, corporations) by means of increase of students ' awareness about these possibilities;

- increase in the share of teachers participating in scientific conferences at home and abroad as invited (plenary) speakers (for example, as part of a teacher reward system);

- the increase in the activity of teachers implementing the EP by publishing the results of the teacher’s methodical activities in the form of textbooks and teaching aids, the creation of teaching and pedagogical schools, etc. (for example, as part of a teacher reward system).

### **Additional material**

The involvement and participation of students and Masters in the implementation of research work lead to the formation of analytical and research competencies of graduates. Examples of research topics carried out with the participation of Masters in the training field “Instrument Engineering” (2019):

1. Development of a method for diagnosing the state of the pressure transducer fitting execution, contract 2005122 of 03/14/2005 between Metran and "SUSU (NIU)", technical task number 69 of 02/15/2019.

2. Development of a prototype temperature sensor with a self-diagnosis function, a grant from Metran for the implementation of project No. 77 (201912714) dated 03/29/2019.
3. Federal Target Program "Development of a domestic mass Coriolis flowmeter for the oil and gas industry with the function of measuring the flow of multiphase flows."

SUSU implements project training. This technology can significantly improve the quality of education and the competitiveness of graduates on the Russian and international labour markets. Projects implemented at the Chair of Information-Measuring Technique as part of project training:

- *Intelligent System for Analysis of Intonational Structures of the Russian Language*

Head: Dmitry Katsay, Candidate of Technical Sciences, Associate Professor

Scientific goal: the creation of an intellectual system for the analysis of intonation structures, implemented in a virtual office and massive open online courses on Russian as a foreign language for native Chinese speakers.

Learning goal: to teach students methods of analysis of speech patterns and their application in the educational process based on modern computer technology.

Tasks: to develop a simplified system of user access to educational resources; introduce the project results into the existing system of electronic support for the study of the Russian language and distance education in Russian; create teaching and learning resources to accompany the study of the Russian language by native speakers of the Chinese language

Audience: 3 Masters of the field Instrument Engineering

Customer: The Ministry of Education and Science of the Russian Federation

- *Design of Intelligent Temperature Sensors*

Head: Vladimir Larionov, Doctor of Technical Sciences, Associate Professor

Scientific goal: create a real prototype of an intelligent temperature sensor with metrological self-diagnostics, which allows to increase the reliability of measurement information and increase the verification interval.

Learning goal: to teach students modern methods of sensors design and intellectual processing of a measurement experiment data.

Tasks: analysis of known methods for construction of temperature sensors with metrological self-diagnostics; design of a mathematical model of the electronic part of the sensor; the study of sensor calibration methods; development of the design of the sensor and its software; manufacture of a prototype and its testing.

Audience: 5 Masters of the field Instrument Engineering

Customer: Metran Industrial Group

**9. *Employer participation in the program implementation***  
**Criterion grade:** excellent

**Strengths of the Program**

- the practically oriented character of training, which is manifested in the content of academic disciplines, the implementation of term papers and final qualification works;
- the existing practice of employers conducting master classes for students of the educational program;
- diverse forms of employers attraction to the program implementation;
- Thus, 100% of the syllabi of disciplines (modules) and practices are agreed with key partners;

**Recommendations**

- attracting employers to participation in the implementation of the program for providing additional resources, including financial;
- involvement of employers in the formation of a fund of test tasks for current control, business cases.

**Additional material**

According to the results of a survey of enterprises and interviews during the site visit, none of the interviewed employers rated the competencies of graduates as not meeting the requirements put forward by them for Masters in Instrument engineering. Under the data obtained, 80% of employers are fully satisfied with the quality of training of graduates of the educational program "Instrument Engineering". At the same time, employers noted that graduates lacked personal and communicative competencies.

**10. *Students' participation in determining the program content***  
**Criterion grade:** excellent

**Strengths of the Program**

- students take part in the management of the program through student government bodies, participate in monitoring surveys; use of the feedback system, etc .;
- the existing teacher rating system in which students participate;
- the involvement of Masters in pedagogical and research activities contributes to their involvement in the process of developing and improving the educational program.

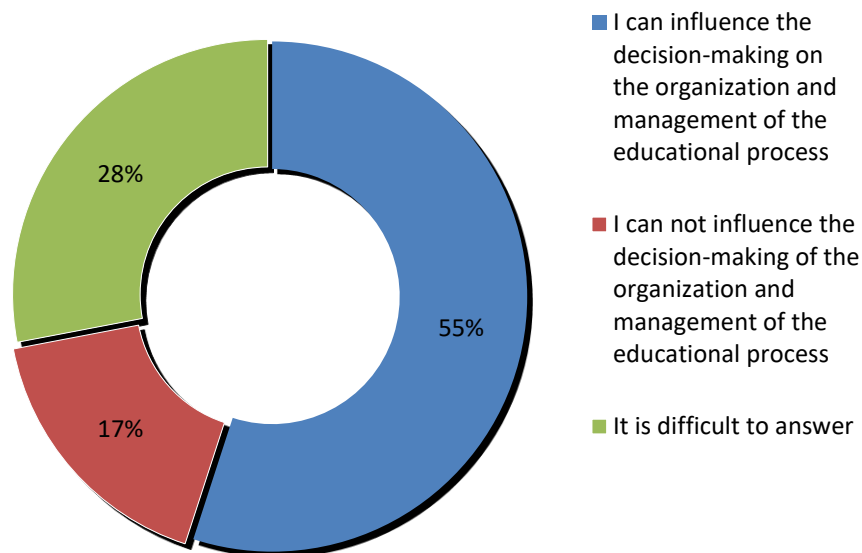
**Recommendations**

- involving students in the formation and development of teaching aids (TLA) of the program, including the development of case studies;
- provide the opportunity for students to receive comments from teachers on their suggestions for changes of the program content.

### **Additional material**

During the site visit, the experts analyzed the students' ability to influence decision-making on the organization and management of the educational process. The chart shows data reflecting this opportunity. Based on the analysis of the data presented, the reviewers conclude that only about 55% of students believe that they are involved in the management of the educational process, and recommend that the program management step up students' activities in this direction.

**Student participation in the management of the educational process**



### **11. Student services on the program level**

**Criterion grade:** good

#### **Strengths of the Program**

- functioning in the organization of projects and structural units, the activities of which are aimed at shaping the personal qualities of students: Young Leader School (an educational project whose goal is to develop leadership and communication skills, develop professional competencies), the TOP-500 Advisory Center (psychological support), student councils of higher schools and institutes (acquiring teamwork skills, teaching the project approach in real tasks); Center for

Creativity and Leisure of the SUSU; summer student health camp "Olympus"; 25 student associations, student council of a higher school, 26 creative groups.

- the current system of encouraging students for achievements in extracurricular activities, including scholarships accrued based on regulatory documents;

- various internship programs lasting from one semester to several semesters. Additional professional education (advanced training and professional retraining) in more than 500 educational programs lasting from 16 to 2000 hours;

- the presence of the Student Practice and Employment Department, which organizes individual consultations for students and graduates on resume writing, holds Career Days, where students undergo training on employment, consultations with employers.

### **Recommendations**

To intensify the work of involving Masters to master various additional programs and courses that promote professional training, the development of general cultural and professional competencies, paying particular attention to language training (foreign languages): conducting classes, master classes in English, round tables and/or conferences for application of knowledge obtained from additional programs and knowledge courses.

### **Additional material**

During the site visit, the reviewers were presented with documents confirming that students had attended additional courses and programs. Based on the analysis of the data presented, the experts conclude that students poorly participate (only 5% of students in EP) in additional programs and courses and recommend encouraging students to get additional qualifications.

## ***12. Career guidance and applicants training***

***Criterion grade:*** excellent

### **Strengths of the Program**

- organization of consultations for applicants, the presence of a specialized feedback system, for example, on the university's website.

- a large number of different career guidance events to attract Russian and foreign applicants held throughout the year, for example, in 2018: SUSU Open Doors Day, HSE Open Doors Day, Global Game Jam, One Hundred Roads, One is Yours, Supercomputer Day, Online Open door day of the HSE ESC for parents (region and Russia), Strategic session with the winners of the "Star", April Saturdays HSE, the Cosmonautics Day.

- upon admission to the magistracy, the calculation in the rating of the applicant includes testing in the field of study, as well as the individual achievements of a potential Master student during an interview with the head of the

training field: victory in the Zvezda multidisciplinary engineering Olympiad. <https://www.susu.ru/en/news/2019/04/12/v-zavershilas-mnogoprofilnaya-inzhenernaya-olimpiada-dlya-shkolnikov-zvezda>), as well as participation in student scientific conferences, the competition of diplomas, articles and other scientific activities;

- pre-master and pre-postgraduate training with the participation of potential applicants in international student programs: Participation in academic mobility programs (passing 1-2 semesters of study in foreign universities with subsequent recognition of the studied disciplines); Passing a summer professional language internship with obtaining a professional certificate with in-depth study of a foreign language; Joint international Master's program "Master in IT Technologies" with Clark University (USA); Additional to higher education "Translator in the field of professional communication"; European Diploma Supplement DIPLOMA SUPPLEMENT; Opportunities for obtaining personal financing of student research projects under the program "U.M.N.I.K."

### **Recommendations**

- record and publish on a global network on the University's website or on popular social networks, including YouTube, master classes and special courses conducted by guest lecturers or issue electronic copyright training courses in order to educate and attract a larger audience, to increase the popularity of the University not only in nearby regions;

- taking into account the orientation of the University to the region and the comparative remoteness of the University, it is necessary to develop a system of remote career guidance and attract applicants through the organization of the course on the University portal of video lectures of major scientists involved in the educational process.

## REVIEWER'S CVs

Name of expert: Nataliya Vetrova

Job location, title	Moscow State Technical University named after N. Bauman, Chair of Instrument-Engineering Technologies (Associate Professor); Research Institute of Radioelectronics and Laser Technology MSTU named after N.Bauman (Senior Researcher);
Academic rank and degree	Candidate of Technical Sciences
Honored Titles	No
Education	University degree
Professional achievements	Member of the Academic Council of the Scientific and Educational Complex "Radioelectronics, Laser and Medical Technology" MSTU named after N. Bauman, The author of more than 50 scientific papers in the field of reliability of technical systems and nanotechnology Winner of the contest "Golden Names of Higher Education - 2018"
Area of expertise	Instrument making, nanotechnology, reliability of technical systems
Practical experience in the field of the program under evaluation	15 years

Name of expert: Eduard Petlenkov

Job location, title	Tallinn University of Technology (TUT ) Associate Professor, Chair of Computer Systems, Head of the Center for Intelligent Systems,
Academic rank and degree	PhD
Education	University degree
Professional achievements	Member of the Qualification Assessment Council in the field of information technology and telecommunications (established by the Government of Estonia) Board Member, TUT Computer Systems Department Member of the Project Management Committee COST CA15225 "Systems of fractional order, analysis, synthesis and their importance for future design." Member of IFC on Artificial Intelligence in the Supervisory Technical Committee Member of the Estonian Society of Systems Engineers
Area of expertise	Natural sciences and engineering, telecommunications



Name of expert: Vladimir Umanets

Job location, title	Deputy Head of the Design Bureau Chelyabinsk Radio Plant "Poliot"
Academic rank and degree	No
Honored titles	Honorary Radio Operator
Education (specialty, educational organization)	SUSU, design and manufacture of electronic equipment, qualification engineer-technologist, designer of REE
Professional achievements	
Area of expertise	wire construction, non-destructive ultrasonic testing
Practical experience in the field of the program under examination	since 1979
Experience as an expert (Agency, name of educational organization, analyzed educational programs)	-

Name of expert: Artyom Mishakov

Job location, title	Student, Bauman Moscow State Technical University (BMSTU)
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