APPLICATION

Study field "Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science" for assessment

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
Title of the higher education institution	*Transporta un sakaru institūts*
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Self-evaluation report

Study field "Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science"

Transport and Telecommunication Institute

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1. Information on the Higher Education Institution/College

1.1. Basic information on the higher education institution/ college and its strategic development fields,.

The Transport and Telecommunication Institute (henceforth *TSI*) is a higher education institution of applied sciences, which offers the full cycle of higher education in computer sciences and electronics, robotics, aviation engineering, transport and logistics, management.

On September 6, 1999 the joint stock company *Transporta un sakaru institūts* (*Transport and Telecommunication Institute)* was registered and the day became known as the TSI Foundation Day. Nowadays, in according with the TSI Constitution, September 6 is the TSI Celebration Day.

TSI received the certificate of its registration as the educational establishment on November 21, 2001 (registration No. 339 4801782). On January 25, 2002 TSI was accredited for the indefinite period (accreditation page No. 032). TSI was registered as a research institute in the Scientific Institute Register on February 27, 2006 (registration certificate No. 432062).

So far the total number of the graduates of the Institute has exceeded 8900 people. Students that pursue their education at TSI come from Latvia, Kazakhstan, Ukraine, Uzbekistan, Moldova, Russia, Azerbaijan, India and other countries.

TSI conducts multifaceted scientific research activities in the areas of strategic specialisation defined in the Constitution: *Engineering and Technology* and *Social Sciences*, covering the educational thematic groups of *Computer Science and Engineering and Technology*; and *Business and Administration* and *Transport Services*.

Implemented study directions and the program numbers at TSI

The Transport and Telecommunication Institute implements academic and professional study programs in 5 directions across 2 departments (see Figure 1):

- Information Technologies, computer hardware, electronics, telecommunications, computer management and computer science – 3 Bachelor's programs, 3 Master's and 1 doctoral program;
- Mechanics and metalworking, thermal power engineering, heat engineering and machinery – 1 Bachelor's program;
- Transport services - 2 Bachelor's programs and 1 Master's program;
- Management, administration and real estate management – 1 Bachelor's program and 2 Master's programs, and 1 doctoral program.

Fig.1. Number of students in study directions implemented at TSI over the reported period.

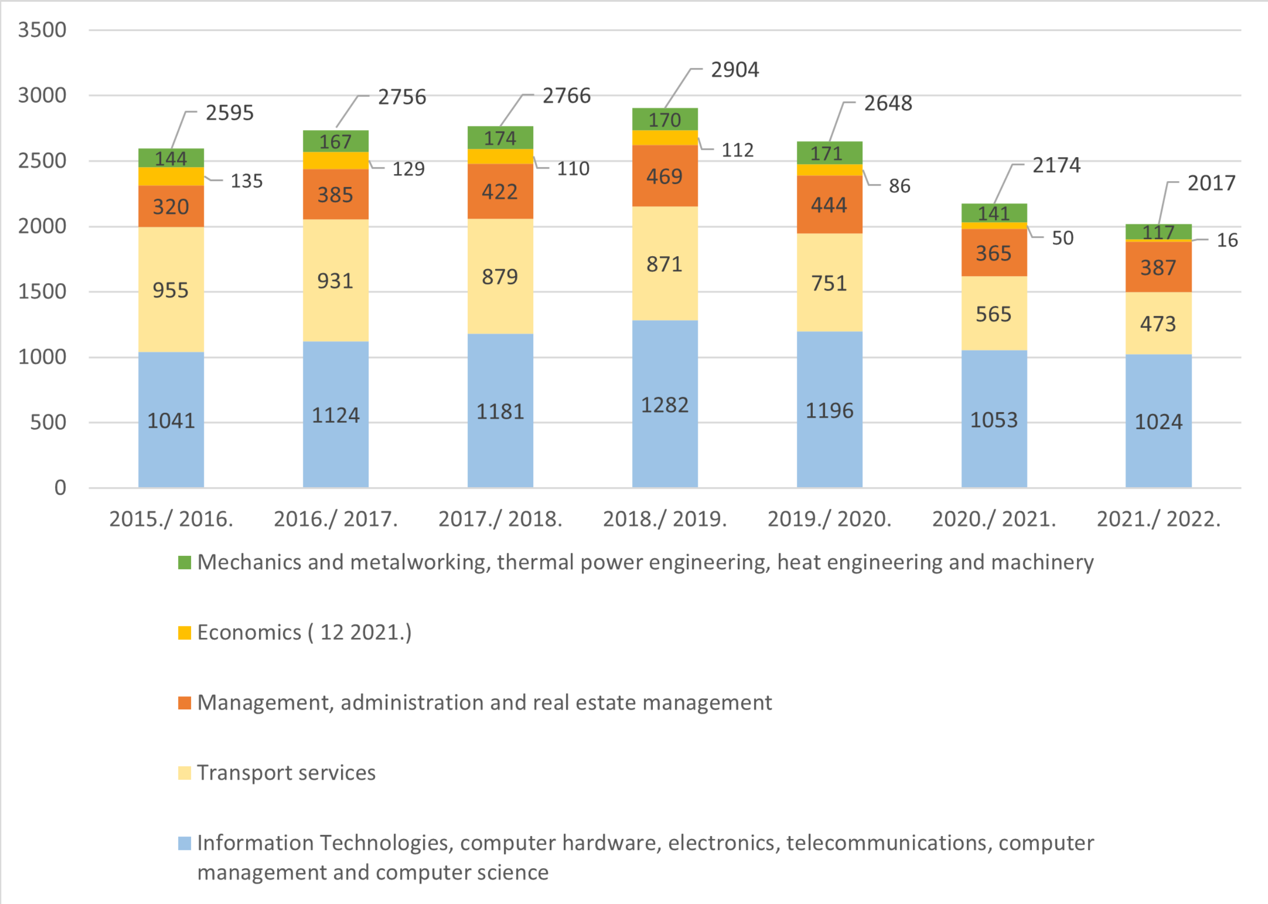


Fig.1. Number of students in study directions implemented at TSI over the reported period

TSI vision is to be the leading private technical University in the Baltic Sea region

TSI mission is to create and disseminate knowledge and make a positive difference to our community and the wider Baltic Sea region.

The strategic TSI aim is to make TSI a modern international technical university with a competitive set of higher education programs, a research and innovation plan, and a lifelong learning offer that meets the needs of all our target groups - students, employees, partners, our society and the region.

In its development strategy for 2020-2025, TSI has identified five strategic priorities: international involvement, education, research and knowledge transfer, business and society involvement, personnel.

The aim of *international involvement* is to increase the number of foreign students and increase the level of student preparedness by strengthening the TSI position as a leading private university in the Baltic Sea Region that offers higher education in computer science, electronics, robotics, transport, logistics and aviation. Establish a strong and deep strategic partnership with a British university, thereby enhancing the set of TSI study programs and research projects.

The aim of *education* is not only to develop study programs in computer science, electronics, robotics, transport, logistics and aviation, to attract an international audience by providing studies in a flexible format in English, but also to offer a wide range of lifelong learning opportunities.

The aim of *research and knowledge transfer* is to train graduates that meet the demands of the industry and of the changes in business operations, business organizations and public life of the next industrial revolution. As for the *research* area, there will be set up an appropriate number of targeted, multidisciplinary research clusters addressing key societal challenges that might have a national or international impact.

The *business and society involvement* involves strengthening partnerships with employers in the region so that the TSI study programs are based on the needs of partner companies and provide internship opportunities for TSI students. It also focuses on encouraging partners to contribute to the enhancement of the TSI research programs and share the essential information so that research results have an impact on business and bring positive changes to society.

The aim of *staff development (personnel)* is to attract and develop excellent staff as well as to provide all employees with opportunities and support for personal development and high performance.

The full version of the Strategy of the Transport and Telecommunications Institute for 2020-2025 is available on the TSI website in Latvian and English at https://tsi.lv/wp-content/uploads/2020/07/TSI-Strategy-2020-2025.pdf

1.2. Description of the management structure of the higher education institution/ college, the main institutions involved in the decision-making process, their composition (percentage depending on the position, for instance, the academic staff, administrative staff members, students), and the powers of these institutions.

Description of the TSI governing body

The general structure of the Transport and Telecommunication Institute was approved on September 28, 2021 at the TSI Senate sitting. The information is published in Latvian and English on the TSI website at https://tsi.lv/about-us/structure-and-government/.

Description of the main TSI decision-making bodies

The TSI activities are regulated by the Constitution of the Transport and Telecommunication Institute, Law on Higher Education and other external and internal regulations. According to it, decision-making at TSI is ensured by the Constitutional Assembly, Senate, Audit Committee, Academic Arbitration Court, Board, Rector, Vice-Rectors, Student Self-Government, Faculty Councils and Study Direction Councils.

The highest decision-making body of TSI in strategic and financial matters is the Supervisory Board of the Joint Stock Company Transport and Telecommunication Institute appointed by the founders. In turn, the Management Board of the Joint Stock Company ensures the implementation of the decisions of the Supervisory Board as well as the management and control of the operational activities of the Joint Stock Company. (Article 14 of Part III of the TTI Constitution https://tsi.lv/wp-content/uploads/2022/06/transporta-un-sakaru-institu%CC%84ta-satversme_lv_eng.pdf). Considering that TTI is a joint-stock company according to its legal status, its operation is also regulated by the Commercial Law and other legal documents and regulations in force in the country, which determine the work of private commercial companies. The composition of the Council and the Management Board of TTI is registered in the Enterprise Register and can be consulted in the Lursoft database. The activities of the Council and the Board of the joint stock company, including their functions, tasks, rights, etc. regulated by Articles 291 - 311 of the Commercial Law.)

The highest representative, governing body and decision-making body in academic and scientific matters is the Constitutional Assembly. The Constitutional Assembly adopts and amends the TSI

Constitution, elects and revokes the Rector, the Academic Arbitration Court and the Senate (in accordance with the Constitutional Assembly Regulations). The Constituent Assembly consists of 50 persons, of whom 30 people (i.e. 60%) hold elected academic positions, 10 people (i.e. 20%) are representatives of general staff and 10 people (i.e. 20%) are student representatives.

The Senate is the highest academic decision-making body of TSI, responsible for the excellence, development and compliance of the university education, research, creative activity and compliance with internationally recognized quality standards. The Senate regulates the academic, creative and scientific activities of the university.

According to the by-laws of the Senate, the Senate comprises the following permanent committees: the Development Committee, Study Committee, Regulatory Enactment Committee and Competition Committee. The Senate is composed of 21 Senators: including the Rector ex officio, and 20 (twenty) elected Senators, including fifteen (75%) representatives of the academic staff of TSI, four (20%) representatives of the students and one (5%) representative of the general staff.

In accordance with the by-laws of the Academic Arbitration Court, the Academic Arbitration Court consists of representatives of the students' self-government and academic staff. The Academic Arbitration Court is made up of five members: 3 academic staff and 2 student representatives. The Academic Arbitration Court examines the applications of the staff of the higher education institution on challenging administrative acts or actual actions issued by TSI, reviews the issues stipulated by the Law on Higher Education Institutions and the Constitution of TSI, and also performs other functions in accordance with the laws in force and the current regulatory enactments.

In accordance with the TSI Constitution, the Rector carries out general administrative activities in academic and scientific fields of the TSI specialization. In coordination with the TSI Board, the Rector represents the Institute in financial matters. The Rector is responsible for the quality of education and science as well as the promotion of staff development and academic freedom.

Effective management and supervision of business operations are conducted by the Vice Rector for Academic and Scientific Affairs and the Vice Rector for Studies as well as academic, research and administrative structural units under their supervision.

The students’ self-government is an elected and independent body representing students’ rights and interests. It operates in accordance with the by-laws of the Students’ Self-government and represents students’ interests at the Constitutional Assembly, in the Academic Arbitration Court, Senate, Faculty Councils and Study Direction Councils. In the Senate, students’ representatives have a veto right on issues pertaining to students’ interests.

In accordance with the Faculty Regulations, the Faculty Council is a collegial body management institution consisting of the head of the faculty, representatives of the permanent staff of the faculty, external employers and representatives of the students' self-government. The Council is elected at the general meeting of the faculty.

Study Direction Councils (following the regulations of the Study Direction Council https://tsi.lv/wp-content/uploads/2020/12/studiju-virziena-padomes-nolikums_eng.pdf) evaluate the compliance of study programs with the requirements of legislation and the labor market, discuss assessments provided by external experts and coordinate plans aiming at the elimination of shortcomings, discuss and coordinate study plans and study program development plans. The composition of the Study Direction Council is approved by the Rector's order.

Participation of external partners in decision-making

External partners are involved in the activities of the Study Direction Council, Faculty Council as well as Alumni Association and the International Scientific Advisory Council.

The Study Direction Council includes cooperation partners from relevant higher education institutions.

Employers are included into the Faculty Council. The Faculty Council reviews and tackles issues related to the planning of faculty activities.

Founded on January 30, 2016, the TSI Alumni Association promotes cooperation between the Institute and its alumni by creating a positive environment for the exchange of experience and business contacts, offering opportunities for raising qualifications, promoting and supporting TSI, and thus, suppporting education processes at the Institute.

The International Scientific Advisory Board is composed of leading international experts and researchers in the scientific fields relevant to the TSI research program. The Board members are approved by the order of the TSI Rector. The Board evaluates the TSI research activities and advises on global and strategic research directions.

Participation of structural units in decision-making

The TSI structural units include faculties, research and study laboratories, administrative departments and units, which operate in accordance with regulations approved by the Senate.

The faculty comprises units of one scientific or one professional direction or of several directions and is chaired by the Dean

The involvement of structural units in decision-making and budget planning at TSI proceeds in accordance with the financial management plan and is monitored and analyzed by the heads of the Financial Responsibility Centers. The Financial Responsibility Centers (FRCs), in accordance with the approved Budget Policy, are the TTI structural units specified in the organizational structure of the Institute of Transport and Telecommunications, which can influence the relevant types of revenues and/or expenses (items) and can take responsibility for these revenues and/or expenses. The Financial Responsibility Centers are financial accounting units, not organizational units, and therefore are not included in the TTI organizational structure. The main functions of the FRCs are as follows:

- participate directly in the budget planning process;
- determine the goals and tasks of the FRCs and coordinate them in general with the goals and tasks of TTI;
- prepare a plan of events for the fulfillment of goals and tasks;
- express goals, tasks and measures in figures, developing a detailed FRCs budgets;
- prepare a monthly report for TTI management on the execution of tasks, measures and goals in the prescribed format;
- perform corrective actions within the approved deadlines.

The budget is formed based on the needs of responsibility centers, and its resources are allocated consistently with the approved plan. The financial plan provides for a separate development fund, which is aimed to support research activities. Annual activities and the budget plan are developed considering the needs of structural units and the results of the current year.

The budget plan for the unit is drawn up by its head upon assessing the efficiency of use of resources considering both technical and human resource aspects and in collaboration with this unit’s staff as well as attracting and consulting personnel of other units. The head of the unit agrees upon this plan with his/her immediate supervisor, considering the hierarchical management scheme of the Institute.

Along the similar lines is the annual performance plan drawn up. In this plan, the head of the unit reviews information on the current work processes (which are more relevant to the core functions of the unit) and on strategically sound projects that contribute to the development of the unit and increase its efficiency. In turn, the performance of the faculty, the budget planning and control are conducted by the dean in accordance with the by-laws of the faculty.

Therefore, the detailed planning of the budget includes specific responsibilities, as units should conduct their activities within the approved budget resources. To implement new projects and innovations, TSI sets up working groups and organizes discussions and seminars, thus encouraging the involvement of staff and managers in decision-making.

1.3. Description of the mechanism for the implementation of the quality policy and the procedures for the assurance of the quality of higher education. Description of the stakeholders involved in the development and improvement of the quality assurance system and their role in these processes.

The quality policy is the declaration of the TSI Board pertaining to the quality of aims and principles, which the Board follows when organizing the development of educational products and study processes. The quality policy is documented and approved in the quality manual. The quality manual is the main document of the TSI quality management system. The current (fourth) version of the quality manual was approved on April 15, 2021. The quality policy is based on the TSI Strategy.

The quality policy is available on the TSI website in Latvian and English (at: https://tsi.lv/wp-content/uploads/2021/08/tsi-qm-v5_eng.pdf).

The overall quality of the activities of TTI, including the compliance of the quality management system of the university with international requirements, is confirmed by the fact that TTI has been positively assessed by external auditors for several years for compliance of the higher education services and scientific research activities with the ISO 9001:2015 standard.

TSI's Strategy and Quality Policy are implemented through the TSI's operational directions. This process is reflected in Fig. 2. The hierarchy of TSI plans is shown in Fig. 3.

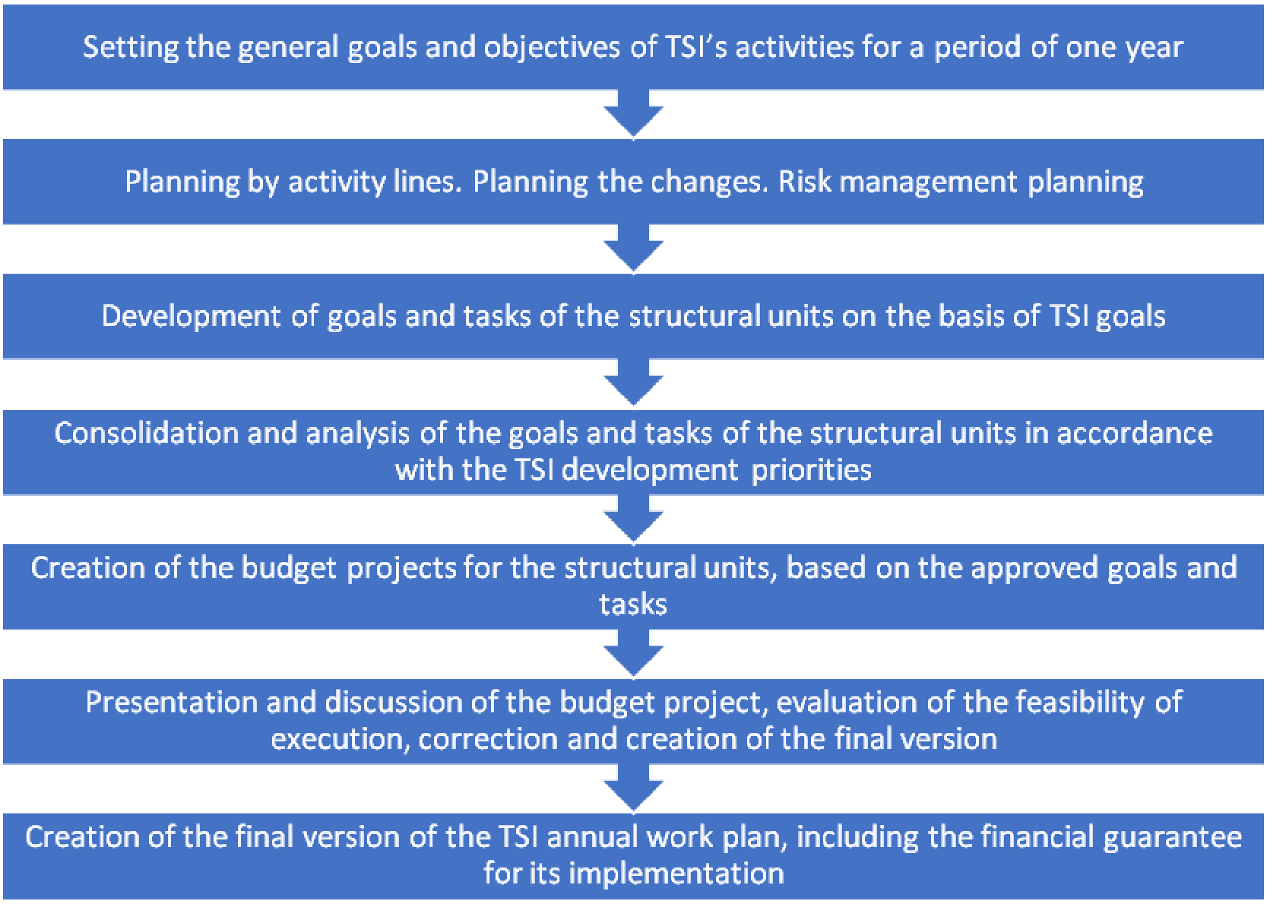


Fig.2. Scheme of the planning process

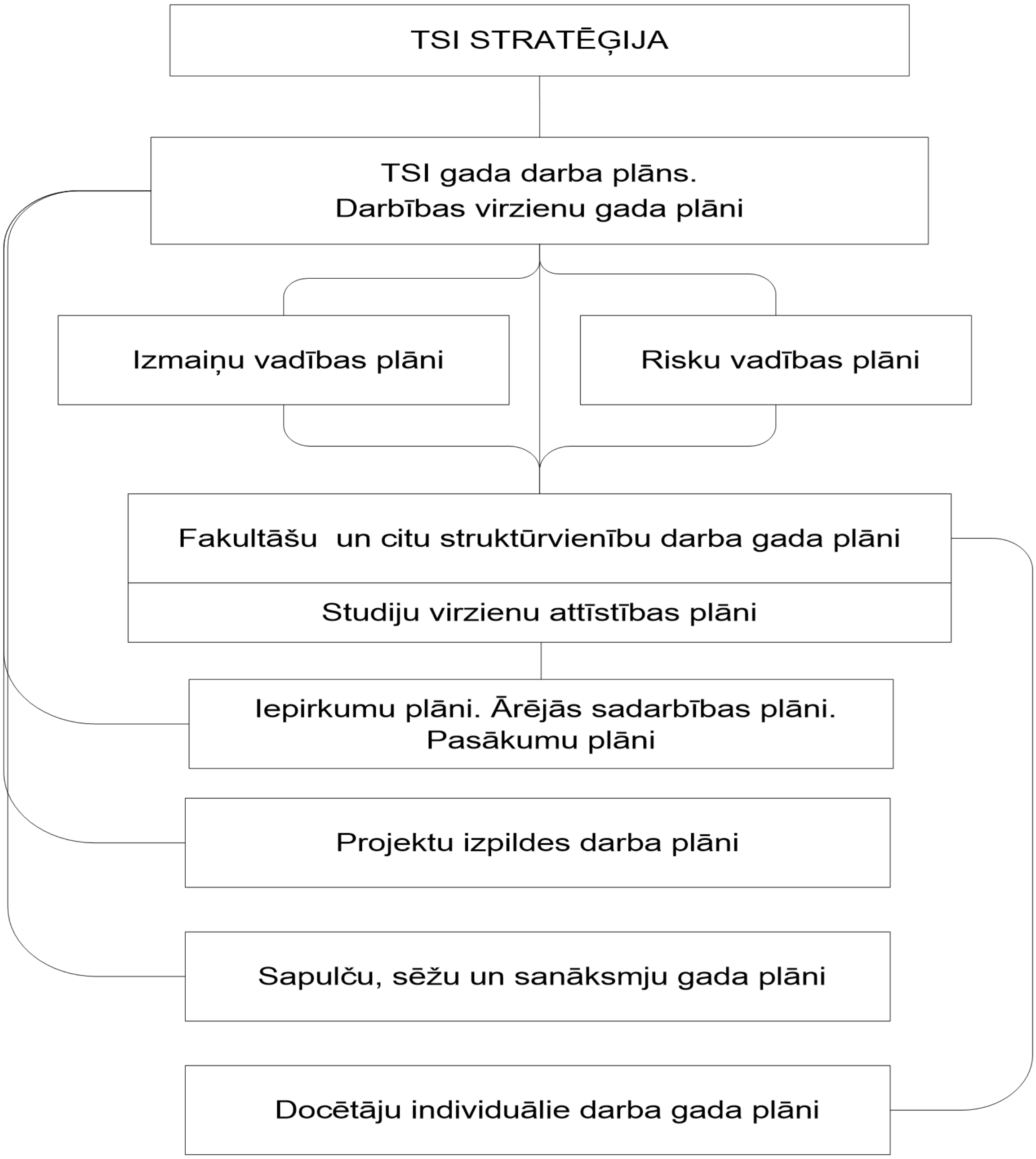


Fig.3. Scheme of the planning process

Procedures for quality assurance in higher education

The quality assurance of the TSI education services is based on the quality management system designed in accordance with the requirements of the ISO 9001 standard. It consists of processes whose structure is illustrated in Figure 4

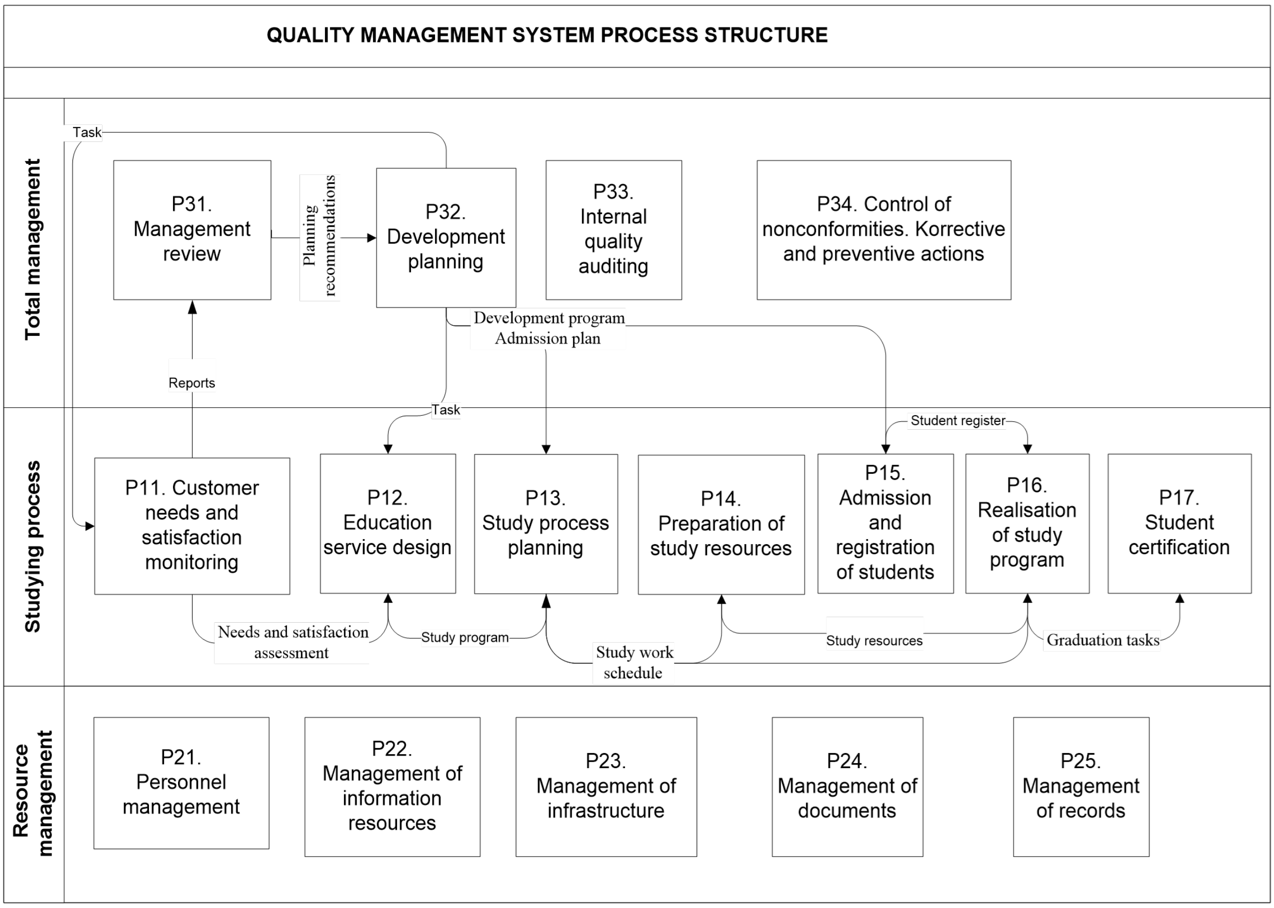


Fig.4. Structure of the quality management processes

Consistent with ISO 9001:2015 Quality Management System Requirements, the TSI quality assurance and enhancement processes are conducted at different levels.

The lower level assesses learning outcomes (examinations, tests, final examinations). The next level focuses on the control of lesson processes (whether resources and methods meet relevant requirements). The third level is characterized by the control and audit of management processes. At the fourth level the Board evaluates the compliance of educational products and services with the market and employer demands, legislation as well as their transformational trends. At the highest, fifth, level, resources and opportunities are analyzed and development strategies are designed (see Figure 5).

Fig. 5. TSI quality assurance and enhancement processes

1.4. Fill in the table on the compliance of the internal quality assurance system of the higher education institution/ college with the provisions of Section 5, Paragraph 2(1) of the Law on Higher Education Institutions by providing a justification for the given statement. In addition, it is also possible to refer to the respective chapter of the Self-Assessment Report, where the provided information serves as justification.

1.	The higher education institution/ college has established a policy and procedures for assuring the quality of higher education.	The developed and implemented quality management system meets the requirements of the ISO 9001:2015 standard. It determines the field of the quality policy and the structure of quality management processes. More information is available in the description of the criteria 1.3., 2.2.1.

2.	A mechanism for the creation and internal approval of the study programmes of the higher education institution/ college, as well as the supervision of their performance and periodic inspection thereof, has been developed.	The procedures for the development, internal approval, implementation of amendments and periodic examination of study programs are stipulated in the Regulations on Study Directions and Study Program Management. The management of the development and implementation of collective study programs is ensured by the Study Direction Boards. Regulations on Study Direction Councils was approved by the Senate on May 21, 2019. Students, graduates, employers and external experts are involved in the development of study programs, annual evaluation and program enhancement by participating in Study Direction Councils, Faculty Concils, Senate Committees, Senate and completing questionnaires. Students, graduates and employers are engaged in the development of study programs and study directions within the framework of the program self-assesssment procedure. The periodic review of the program takes place during annual self-assessment. The course of the annual self-assessment, deadlines and persons responsible for these matters are approved by an order in September each year. More information is available in the description of criterion 2.2.2

3.	The criteria, conditions, and procedures for the evaluation of students' results, which enable reassurance of the achievement of the intended learning outcomes, have been developed and made public.	Lecturers inform students about the knowledge assessment criteria and methods during the first class. The assessment methods and criteria of learning outcomes are included in the course description and are available to students in the e-learning system. Study programs that include internships are designed in such a way that during their internships students consolidate the knowledge acquired in courses and develop practical skills. To assess graduation theses, internship reports and final examinations, there have been established committes that include representatives of employers. The committee members are informed about the basic principles of assessment. The degrees and professional qualifications awarded to students upon successful completion of their studies are regulated by national standards of higher education. The Regulations on the Award of Professional Bachelor's Degree, Professional Master's Degree and professional qualifications at the Transport and Telecommunication Institute describe the procedures for organizing final examinations and determine duties, actions, terms for both students and staff. Assessment criteria and methods for final examinations are included into the Methodological Guidelines for Writing Graduation Theses as well as into the Regulations for the Award of Academic Bachelor's and Master's Degrees and Regulations for the Award of Professional Bachelor's Degree, Professional Master's Degree and Professional Qualifications. The criteria for evaluating the study results of the doctoral programme are described in the Regulations on Doctoral Studies, and the procedure for awarding the Doctoral Degree - in the Regulations on the Procedure and Criteria for Awarding the scientific Doctoral Degree (Doctoral Dissertation). Learning outcomes achieved in prior education or professional experience are recognized in accordance with the TSI Regulations on the Evaluation and Recognition of Prior Learning and Professional Experience. The procedures are included into the Final Examination Regulations and Regulations on Study Procedures, which additionally describe the system of assessment of learning outcomes. Recognition of learning outcomes achieved through participation in the ERASMUS + Programme is regulated by the TSI ERASMUS + Programme Scholarship Instructions. Each students receives an ID card created in the TSI internal information system Intranet. This card contains information on the student's academic progress, student's plan for the entire study period and assessment outcomes, which enables the student to control his/her own study plan and the achievement of the expected learning outcomes. More information is available in the description of the criteria 2.1.5., 2.2.4., 2.3.4.

4.	Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.	The descriptions of academic positions, the Regulations on the election of academic staff and the assessment of their scientific and pedagogical qualifications are approved. More information is available in the description of the criteria 2.3.5., 2.3.6.
5.	The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available, and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college.	Information on student achievements is available in the TSI internal information system. The Study Department collects and analyses information on academic progress indicators, the results of which are regularly reviewed at the Rectorate meetings. Information on student satisfaction is collected through surveys and analyzed at department, faculty, and Institute management levels. During annual attestation the efficiency of academic staff is evaluated. The criteria include indicators of methodological output, student feedback and participation in the Institute management processes. Training aids used in the implementation of study programs are described and evaluated during self-assessment of study programs. Key Performance Indicators (also KPI) of the Institute have been determined. The performance of the Institute and its structural units is periodically evaluated in accord with KPI. Regulations on Student, Graduate and Employer Surveys have been developed. More information is available in the description of the criteria 2.2.4., 2.3.1., 2.3.3.
6.	The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study field whilst implementing their quality assurance systems.	Every year the Senate approves reports on self-assessment of study directions and makes decisions on the compliance of study programs and study directions with the requirements of state accreditation. Every study direction has its own development program, which is consistent with the Institute Development Strategy. More information available is in the description of criterion 2.1.3., 2.2.2, in Appendix 6.

2.1. Management of the Study Field

2.1.1. Aims of the study field and their compliance with the scope of activities of the higher education institution/ college, the strategic development fields, as well as the development needs of the society and the national economy. The assessment of the

interrelation of the study field and the study programmes included in it.

The aim of the study direction is to prepare highly qualified specialists in the field of information technologies, computer science, electronics, telecommunications and robotics with fundamental knowledge and practical skills that would enable them to independently or in a team implement the development, operation, diagnostics, analysis and optimisation of computer systems, electronic and telecommunications systems, robotic/automated systems, as well as to prepare students for further studies in the higher level programmes, scientific activity and further self-education.

The tasks of the study field are as follows:

- To provide students with the fundamental knowledge and practical skills necessary for the profession;
- To develop students' systematic and critical thinking and to promote students' analytical abilities;
- Promote self-education, to develop the ability and skills to acquire information, to analyse it critically and to use it in their field of activity;
- To develop and provide opportunities for students to realize themselves in research, innovation and project activity;
- Develop and foster cooperation between students, industry, academic and scientific environment;
- To provide students with a friendly, modern, multicultural and encouraging environment for studies, research and self-education.

The goals of the study programmes in the field of the study are subordinated to the objectives of the field of study, forming a unified system framework, while reflecting the specificities of each study programme (see the description of each programme for more details).

The objectives of the field of the study and its programmes are derived from the 5 strategic development directions set out in the TSI Strategy 2000 - 2025 (available at: https://tsi.lv/wp-content/uploads/2020/07/TSI-Strategy-2020-2025.pdf) International involvement, education, research and knowledge transfer, involvement of business and community, personnel, and the objectives to be achieved in each direction.

The study field "Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science" comprises study programmes corresponding to the thematic areas *Computer Science and Engineering and Technology* of the Latvian Classification of Education.

1. Professional programme "Electronics", licensed on 13.10.1999.
2. Academic bachelor programme "Telecommunication Systems and Computer Networks", licensed on 11.06.2007.
3. Academic bachelor programme "Bachelor of Engineering in Electronics", licensed on 13.10.1999. In the course of the accreditation process, a change of title to "Computer Engineering and Electronics" was applied for.
4. Academic Bachelor programme "Bachelor of Science in Computer Science", licensed on 13.10.1999. In the course of the accreditation process, a change of title to "Computer Science" was applied for.
5. Academic Master programme "Computer Science", licensed on 13.10.1999.
6. Academic Master programme "Information Systems Management", licensed on 08.10.2009.
7. Academic Master programme "Master of Engineering in Electronics", licensed on 13.10.1999.

In the course of the accreditation process, a change of title to “Computer Engineering and Electronics” was applied for

8. Doctoral programme “Telematics and Logistics”, licensed on 04.12.2002.
9. Bachelor programme “Robotics” licensed on 21.11.2018. Not included on the accreditation page.

In accordance with the development strategy of TSI and the development plan of the field of study, the first two of the programmes mentioned here are not submitted for evaluation, as they will not be implemented as independent ones and will be closed, accordingly improving and expanding the Bachelor programme “Computer engineering and electronics” with relevant specializations (see section 1.1 of the programme description for more details).

Studies in the TSI study direction cover a full three - level study cycle, ensuring the continuity of all levels and specialization options, which allows the efficient continuation of the study process, and improvement of the knowledge and competences acquired by students. Graduates of the academic bachelor study programmes after four years of study can continue their studies in the Master study programmes “Computer Science”, “Computer Engineering and Electronics” or “Information Systems Management”, obtaining academic degrees in relevant field, and then continue their studies in the doctoral degree programme “Telematics and Logistics”.

The study programmes included in the field of the study, covering the thematic areas of computer science and engineering science and technology education, were created to implement the research in the field of engineering science and technology. Such direction of the research is relevant to the Latvian and international labour market and science, and the TSI Constitution defines it as one of the directions of strategic specialization.

The balance between the interconnectedness of the study programmes in the field of study is ensured through the progressive achievement of the learning outcomes both in the dimension the implementation of the study programmes and the levels of higher education. In particular, for the acquisition of basic knowledge of the industry and compulsory civil protection knowledge in bachelor study programmes and for the acquisition of common advanced knowledge of the industry and the latest scientific and practical trends in master study programmes, several study courses are implemented in all or several study programmes at the same level simultaneously for all students. For example, in the 1st and 2nd year of the Bachelor study programmes the study courses “Higher Mathematics”, “Programming”, “Occupational Safety, Civil and Environmental Protection”, “English for Foreign Students”, etc. are implemented simultaneously for all students. On the other hand, for the senior students, in addition to the courses taught simultaneously to the students of the Bachelor degree programmes, a number of programme - specific courses are taught to the students of two Bachelor degree programmes or two specialisations, for example, “Software Engineering”, “Computers”, “Operating Systems and Systems Programming”, “Fundamentals of Data Science”.

This principle of gradual acquisition and development of common and specialised knowledge, skills and competences in the field is also implemented in the master level study programmes of the field of study.

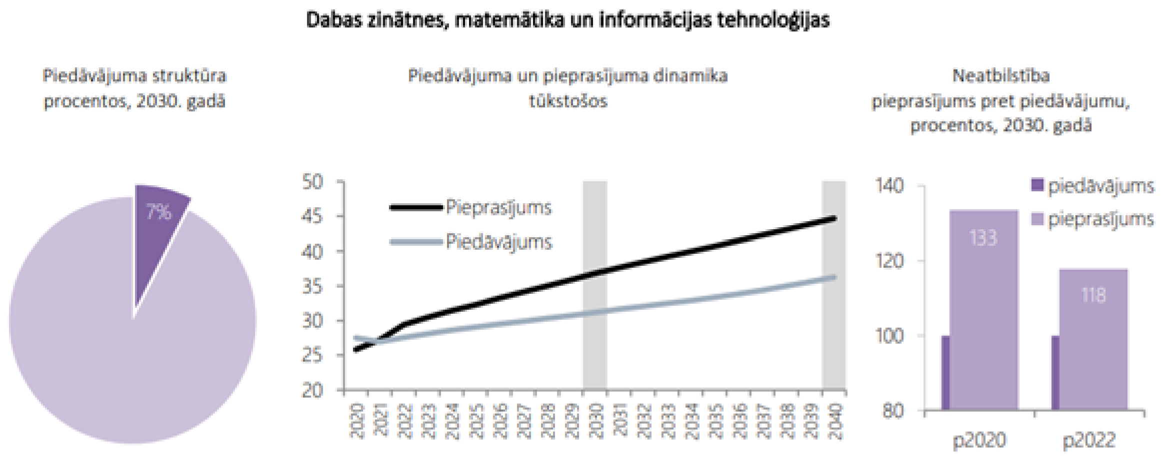
This gradual development of learning outcomes within the framework of both programmes and levels of study ensures an appropriate and relevant balance between the programmes of study included in the field of study.

The field of study " Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science " corresponds to the field of smart specialization "Information and Communication Technologies ". The specified area is an area with a direct horizontal investment transition in the development of smart areas of specialization - Bioeconomy, Biomedicine, Smart Materials and Technologies, Smart Energy, and it plays a significant role in fostering the transformation of the national economy in order to promote the growth of high and medium-high technologies in the export of Latvian goods and services.

In the field of Information and Communication Technology specialization, Latvia has developed the research and innovation in the following thematic niches (there are indicated only those areas that correspond to the TTI study programmes and to the TTI research pillars): algorithms, machine learning, business process management systems, electronics, smart sensors and the Internet of Things, robotics, large data, data storage, transmission and systems. This shows that all the study programmes, offered within the field of study, will correspond to the field of smart specialization.

The informative report of the Ministry of Economy of the Republic of Latvia on medium- and long-term labour market forecasts (https://www.em.gov.lv/lv/media/14720/download?attachment, available only in Latvian) states that "if the current structure of higher education supply is maintained, the most significant labour shortage in the higher education group is expected to be for the specialists with education in Engineering, Natural Sciences and ICT (STEM) fields. The shortage of specialists with the relevant qualifications could exceed 9 000 specialists by 2030, mainly in the fields of computer science, architecture and construction, physical sciences and engineering.

The report explains, "Despite the fact that fewer specialists with STEM education are still being prepared than will be needed in the labour market in the coming years, the situation has improved significantly compared to the EM labor market forecasts for 2020, when there was projected more than 19 thousand shortage of specialists with STEM education for 2030. It should be noted that the proportion of STEM graduates in the total number of graduates has increased from 13% to 19% in the period from 2008 to 2021, which has also increased the supply of young specialists on the labor market."



Dynamics of supply and demand

The electronics and electrical engineering (E&E) sub- field is also projected to face a shortage of workers in the labour market, according to the data of the Ministry of Economy "By 2035, the number of jobs in the E&E sectors could increase by 1.9 thousand. The largest job growth is expected in the production of electronic components and boards, the manufacture of wiring and installation devices, and the manufacture of the communication equipment. Half of the total job growth in the E&E industries is expected to be in specialised E&E occupations". At the same time, it is important to note that in the electronics and electrical engineering manufacturing segment, it is difficult for Latvia to compete with labour-abundant countries such as China or India, so the development trends of the E&E industries will be mainly determined by strong specialisation and orientation towards niche products with high added value and low labour intensity, which require highly qualified specialists not only in the field of electronics and electrical engineering, but also in other related fields. Normunds Bergs, the President of LETERA, points out "Electric machines, electronics and IT, not to mention robots and artificial intelligence, will increasingly define the modern civilisation now and in the future. Take it all away and we will very quickly revert back to the Stone Age." This means that demand in this area will be consistently high in both Latvia and the EU.

In general, it should be concluded that the field of study and the programmes included in it meet the needs of both Latvia's smart specialization and the national economy.

2.1.2. SWOT analysis of the study field with regard to the set aims by providing explanations on how the higher education institution/ college expects to eliminate/ improve weaknesses, prevent threats, and avail themselves of the given opportunities, etc. The assessment of the plan for the development of the study field for the next six years and the procedure of the elaboration thereof. In case there is no development plan elaborated or the aims/ objectives are set for a shorter period of time, information on the elaboration of the plan for the development of the study field for the next assessment period shall be provided.

To ensure the quality of the field of study, an annual self-assessment of the fields of the study and programmes is carried out, reviewed by the Council of the Field of Study and approved by the Senate. The self-assessment includes an evaluation of the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the Field of the Study. The SWOT analysis is used to develop the proposals for the improvement of the Field of the Study and its programmes.

S – Strengths

- TSI educational services are certified according to the ISO 9001:2015 standard and the study programme quality management system has been implemented;
- The study field implements the full-cycle higher education, offering Bachelor, Master and Doctoral level programmes;
- TSI is the only private university with its own doctoral programme and Promotion Council in the field of Engineering and Technology in Latvia;
- The international evaluation of Latvian scientific institutions in 2021awarded the university ratings on a scale from 3 to 4; TSI was recognized as a strong-level scientific institution in Engineering and Technology;
- The university information technology infrastructure (including laboratories) meets the modern requirements, it has valuable experience in digitisation of the study processes and distance learning;
- Opportunities for students to obtain professional ICT certificates; specialised partnership agreements with Microsoft, CISCO and ORACLE on the establishment of Microsoft Academy, CISCO Academy, ORACLE Academy on the basis of TSI;
- Modern electronic library and subscription to the international databases (Academic Complete, Science Direct, SCOPUS)
- A strategic partnership agreement was concluded with the University of the West of England (UWE, Bristol, Great Britain), which provides for cooperation in the creation of double diploma

programmes, improvement of the teaching methodologies, use of teaching materials, cooperation in the field of research, etc. There are two double degree programmes in the field of the study in partnership with the UWE Bristol;
- Established cooperation and created a wide circle of contacts with employers (e.g. RoboLogic SIA, Accenture Baltics, Deloitte Latvia, Bircle IT and others), entrepreneurs, state institutions and other universities in Latvia and abroad;
- Active work in various associations and societies: Latvian Information and Communication Technology Association LIKTA, Latvian Electrical Engineering and Electronics Industry Association (LETERA), Mechanical Engineering and Metalworking Industry Association (MASOC), Remote Control Aircraft Association (LARPAS), Simulation Modeling Society, European Conference of Transport Research Institutes (ECTRI), Informatics Europe, etc.

W– Weaknesses

- Many students work alongside with their studies to secure funding for studies, which impacting their study results.
- Low activity of students within the ERASMUS mobility programme, as well as the activity of incoming lecturers, although the mobility indicators of TSI lecturers are relatively high;
- Insufficient trend in renewing the composition of lecturers, as well as in attraction foreign lecturers
- Insufficient dynamics (but positive) in attraction of foreign students from the EU countries.
- Insufficient dynamics (but positive) in involvement of students to projects, scientific activities, etc.;
- Limited amount of working capital, which hinders the development of ICT infrastructure for the implementation of the study programmes;

O – Opportunities

- A well determined niche of the university in the educational services market, which corresponds to the field of RIS3 smart specialization “Information and Communication Technologies”;
- The strategy of the European Union envisages the need to increase the number of citizens with higher education in the field of ICT;
- The medium and long-term forecast of the labour market shows that the demand for specialists in the field of Engineering will increase;
- Priority study programmes already implemented by TSI identified at the national level;
- There is an opportunity to focus on attracting students from Western Europe and Asia, as tuition fees are competitive compared to the competing Western European countries. In the period before the Covid-19 pandemic, active marketing activities resulted in a significant increase in the number of international students at TSI each year;
- Many years of experience in implementing the study programmes in the form of distance learning;
- TSI has the opportunity to attract additional funds by participating in the implementation of the European Union fund projects;
- The importance of lifelong learning throughout a person’s life is increasing, which is based on the need to acquire new knowledge, skills, experience in order to increase or change one’s qualifications according to the requirements of the labour market;
- Further cooperation with the UWE Bristol (UK) University provides the opportunity to implement other programmes in the form of a double diploma, for example, Robotics, as well as adopting the best examples of the UWE and increasing the quality of the TSI studies by adapting the UK quality standards.

T – Threats

- Competition with industry in human resource involvement.
- The unequal treatment of private educational institutions and private scientific institutions by the national legislation;
- Unavailability of the state budget funding to the cover tuition fees for students at private universities;
- The technological revolution, which requires the rapid development of the academic laboratories with new generation of STEM oriented equipment;
- The decreasing proficiency level in natural sciences and mathematics among secondary school graduates;
- The decrease in the number of potential students due to the demographic situation in the country, migration and the outflow of people’s intellectual potential to other countries of the world;
- Students’ insolvency due to the restrictions imposed as a result of the COVID19 pandemic, and changes in the external political situation and the related threats;
- The criteria put forward to classify a scientific institution as a research organisation are based only on the proportion of economic and non-economic activities, but not on the specific research outputs. As a result, in 2021, the decision of the Ministry of Education and Culture about the non-compliance of TSI with the definition of a research organisation was made. But in the same time formal criteria still not accepted.

Comparing the Strengths and the Weaknesses of the study field implemented by TSI, it can be concluded that the Strengths are predominant, and in the future TSI also aims to further reinforce and develop them, as well as to eliminate the Weaknesses as far as possible, and to use the development opportunities while avoiding threats in order to achieve the goals set in the TSI strategy.

1. To strengthen the composition of the academic staff in the areas of the study programmes:

- for delivering the professional courses, it is planned to attract more representatives of the industry who are interested in the academic activity, directly using the cooperation partner companies, for instance, Accenture Baltics, Deloitte Latvija, etc.;
- to create a talent recognition strategy for attracting Master and Doctoral levels students;
- to attract the foreign lecturers through ERASMUS + exchange programme, EU-level projects, for example, Marie Curie;
- to sign the cooperation agreements on sharing resources with universities in the Baltic States. In spring of 2022, such an agreement has already been signed with the Kaunas University of Technology
- by 2022 the collaboration agreement was signed with COURSERA, the aim of the agreement is to provide ability to the teaching staff raise their qualification. It is planned that some of the courses will be obligatory for academic staff (primary dedicated to methodological aspects). As example for 2022 the course Assessment in Higher Education: Professional Development for Teachers has been selected as obligatory for academic staff.
- to continue search and implement projects, which are aimed on academic staff development (as example in past it was project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation")

2. To use actively ESF projects (for example, post-doctorate fellowship) to attract the scientific researchers. To establish new laboratories, research clusters and to involve students in their operation.
3. To attract foreign students by implementing an active marketing policy in the Asian market,

as well as in the post-Soviet countries. In order to reduce the future dropouts and to select the highly motivated foreign students, an additional requirement has been set – the entrance exams in profile disciplines: mathematics and /or physics, the English language. To implement the study credit exchange programme with the EU training institutions (for instance, with France)

4. For the development of ICT infrastructure, to use wider attraction of the resources from ERDF funds, to implement the resource sharing activities with other universities and close cooperation with industry.
5. To promote students' interest in the scientific research, it is planned to attract money from ERDF funds. In the fall of 2021, the project "Transport and Telecommunication Institute innovation grants for students" / iDEAHUB (No. 1.1.1.3/21/A/006) has already been launched.
6. The university cooperates with the industry companies (RoboLogic, Birkle IT, etc., grants from industrial partners for covering the tuition fees), actively uses a discount-loyalty system to cover or reduce students' tuition fees: discounts for vulnerable groups of students (with disabilities, large families and others), budget places from TSI. Various types of events are organised where the student has the opportunity to reduce significantly the tuition fee, for example, annual Olympiad in Mathematics and Programming. Students are involved in the paid projects.
7. Active cooperation with the study area associations and societies (LIKTA, LETERA, MASOC and others) with the aim of lobbying the interests of private universities, including the issue of the status of a research organisation.
8. TSI promotes doctoral training for the academic staff by co-financing the doctoral studies, attracting the foreign lecturers through the EU funded projects.

The field of the study development plan for a 6-year period was elaborated based on the TSI development strategy for 2020-2025. The preparation of the development plan of the study area was led by the head of the area, involving the representatives of the TSI administration and all programme directors of the study area.

In the process of working out the development plan of the study area, there were considered the suggestions of the programmes of the study area; the competitiveness of these propositions in the local and international market was reviewed. In the decision-making process, the labour market and the forecasted demand of the potential students were analysed, as well as the effectiveness of the use of resources necessary for the implementation of each programme was evaluated.

The plan is reviewed and accepted by the Council of the Study Field; it includes employers and company representatives, and students of the faculty, approved by the Senate. The annual self-assessment includes elaboration and analysis of measures for implementing the six-year strategy.

2.1.3. The structure of the management of the study field and the relevant study programmes, and the analysis and assessment of the efficiency thereof, including the assessment of the role of the head of the study field and the heads of the study programmes, their responsibilities, and the cooperation with other heads of the study programmes, as well as the assessment of the support by the administrative and technical staff of the higher education institution/ college provided within the study field.

In accordance with the Regulation on Management of the Study Directions and Study Programs, it is the faculty that is responsible for the management of the study direction. The institutions included in the TSI structure participate in the management of the TSI study directions. The structure of the TSI study directions management is given in Appendix 5.

Visualisation of the study direction management processes is provided in the figure below.

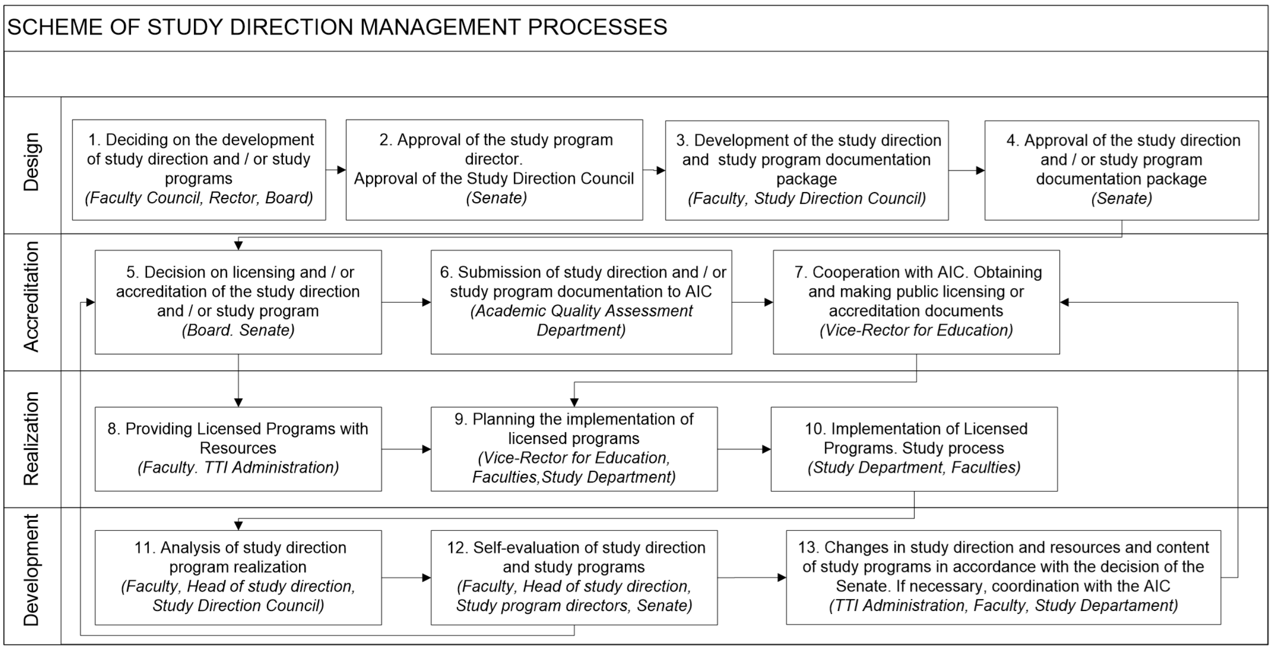


Fig. 6. Scheme of TSI study direction management processes

Such structure of the study process and study program management processes is efficient because the main role in the structure is assigned to the collegial bodies, such as the Faculty Council and the Senate, which evaluate the efficiency of performance of the study programme directors and the heads of the study directions.

According to the scheme of the study direction management process (Figure 11), the Senate participates in processes 1, 2, 4, 5 and 12, while the Study Direction Council and Faculty Council participate in processes 1, 3, 11 and 12.

The collegial bodies periodically request the deans and the heads of the study directions to submit reports on the compliance of the Directions with the accreditation requirements and the aims of the development of the Institute. These bodies also evaluate the efficiency of the management of study programs and study directions as well as make decisions regarding the enhancement of this efficiency.

The head of the study direction is approved in accordance with the Study Direction and Study Program Management Regulations. The head of the study direction ensures the review and evaluation of the study direction and its development planning, external evaluation of the study direction as well as the promotion of cooperation between the directors of the study programs implemented within the study direction and the academic staff.

The programs included in the study direction are managed by the study program directors, who act in accordance with the Study Direction and Study Program Management Regulations.

The director of the study programme is responsible for managing the study process; development and updating of the study programme; development of documentation and methodological guidelines for the final exams (questions for the state exam, requirements for the tasks and content of the final thesis, criteria for its assessment); updating the study courses descriptions; preparation of the annual self-evaluation report of the study programmes; participates in the evaluation and comparison of the relevance of the scope and content of the course of study acquired in another programme or educational institution; participating in advertising campaigns.

The study programmes included in the field of study are implemented at the Faculty of Engineering. The close and regular cooperation between the directors of the study programmes included in the field of study should be emphasised. The programme directors participate in the daily work of the faculty and in regular faculty meetings, where the issues related to current developments in the study process of all study programmes are discussed. The Dean coordinates the regular exchange of views and sharing of experience between the study programme directors and the head of the field, both on the study process in daily work - at faculty and university meetings, and on the stages of reports preparing and development planning - in annual reviews and reports. Programme final examination boards consist not only of the directors of the various study programmes, but also of the representative of the employers invited as the head of the commission. After defence of the final theses the marks are awarded as a result of a joint discussion in which the views of each member of the committee are heard. Consequently, the cooperation between the programme directors in the field of study is regular and continuously coordinated.

The Study Direction Council (SDC) acts as support for the development of the study direction and study programs. It operates in accordance with *the Regulation on the Study Direction Council*. The SDC evaluates the necessity of the development of the study direction and study program in accordance with the contemporary labour market trends in Latvia and the EU, makes proposals for the engagement of independent experts (employers) for evaluation of the topicality and content of the program, discusses and coordinates the development plans of the study direction and study programs, discusses proposals for participation in the projects related to the development of joint programs with the Latvian and foreign higher education institutions and implementation of joint programs, coordinates interfaculty cooperation and adjusts joint matters related to the implementation of the study direction with all the faculties participating in teaching courses within the given study direction.

The SDC composition is approved by the rector’s order, engaging therein the relevant dean, the head of the study direction, directors of the study programs, chairman of the Faculty Council, senior academic staff from other faculties involved in teaching relevant study courses, employers and students.

Close cooperation between the administrative and the technical support staff is also important for the implementation of the study field. The following structural units are involved in the provision of the study process and the implementation of the study directions and study programs:

- Faculties organize the preparation of study directions and study programs for licensing and accreditation and perform periodic self-assessment and improvement of the study directions and study programs.
- Study Department plans the study process (lesson scheduling, lecturer work, etc.) and records study achievement. Additionally, distance learning study forms provide students with access to learning and methodical materials of distance learning study courses; advises students; supervises the fulfilment of the mid - term control and final control requirements of study courses; organizes consultations for students in online or offline mode (according to the lecturers’ consultation schedule and at the request of students).
- The doctoral department organizes and coordinates the doctoral study process in doctoral studies, organizes exams, tests and the annual assessments of doctoral students.
- Digitization and Innovation Training Center - supervises the development, updating and placement of materials for distance learning study courses on the platforms of the TSI Learning Management System; provides methodological support and advises study programme directors and lecturers on the development of study materials for distance

learning courses.
- Research Administration Department - organizes and supervises the scientific research activities at the university
- Teaching staff of the Faculties include the academic staff and guest lecturers, who prepare and improve the description and content of study courses, prepare study materials, update literature, determine assessment criteria, deliver lectures, conduct seminars and workshops, administer examinations, consultations, perform other academic duties
- Library provides students and academic staff with academic and scientific literature.
- IT Department supports IT infrastructure (computers, printers, etc) and also provides the support in organizing studies in the remote format.

Both faculties and support structural units (Study Unit, Digitization and Innovation Training Center, Research Administration Division, Library, etc.) are closely involved in the implementation and development of the study process, cooperating equally on a daily basis. Cooperation with structural units is coordinated through the study programme managers and lecturers, for example, in the creation of study plans in the TTI system, in the development and approval of the study course descriptions, in the placement of study materials in the e-learning environment, in the organization of the study process and in many other aspects of daily work and development.

In assessing the effectiveness of the management of the study field, it can be concluded that it is of high quality in terms of content and organisation and is well arranged in a transparent manner. It is implemented not only by the director of the study programme, but also by a group of participants consisting of heads of the study programmes, lecturers, course supervisors, student self-government, as well as a special Study Field Council which includes invited lecturers and representatives of professional organizations. In general, we can say that TTI has established a stable system for managing and improving the study programmes, and the support of administrative and technical staff is sufficient.

The Faculty of Engineering provides the management of the TSI study direction “Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”. The head of the study direction is Dr.sc.ing. Professor Mihails Savrasovs.

Appendix 8 contains the composition of the Study Direction Council “Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”.

2.1.4. Description and assessment of the requirements and the system for the admission of students by specifying, inter alia, the regulatory framework of the admission procedures and requirements. The assessment of options for the students to have their study period, professional experience, and the previously acquired formal and non-formal education recognised within the study field by providing specific examples of the application of these procedures.

Description of the student admission requirements and system

Admission to TSI is based on the Admission Rules for the specific academic year approved by the TSI Senate, which are approved by the Senate by the 1st of November each year. The admission rules for the current academic year are published on the TSI website in Latvian and English and are available to everyone.

Admission Rules have been developed and admission proceeds in accordance with external laws and regulations - the Law on Higher Education Institutions, Cabinet Regulation No. 846 of 10 October 2006 Regulations on Requirements, Criteria and Procedures for Admission in Study Programmes, Cabinet Regulation No. 543 of 29 September 2015 *Provisions for the Substitution of a Foreign Language Centralised Examination in the General Secondary Education Programme for a Foreign Language Examination by an International Testing Institution*, as well as other external laws and regulations and taking into account the specific entry requirements of the programmes.

Admission to later stages of studies at TSI is based on Cabinet Regulation No. 932 of 16 November 2004 Procedure for the Commencement of Studies in Later Stages of Studies, Cabinet Regulation No. 505 of 14 August 2018 *Regulations for the Recognition of Competences and Vocational Education and Training Acquired Outside Formal Education or Professional Experience and the Study Results Achieved in the Previous Education*, the TSI *Regulations on the Recognition of Competences and Vocational Education and Training Acquired Outside Formal Education and the Study Results Achieved in Previous Education, the TSI Procedure for the Commencement of Studies at Later Study Stages and other external laws and regulations.*

The admission terms and procedure for citizens and non-citizens of the Republic of Latvia as well as foreigners holding a permanent residence permit in Latvia, are determined in accordance with the general procedure and Paragraph 7 of Cabinet Regulation No. 846 of 10 October 2006 *Regulations on Requirements, Criteria and Procedure for Admission to Study Programmes*. The right of foreign nationals without a permanent residence permit to study at a higher education institution is governed by the requirements of Sections 83, 84 and 85 of the Law on Higher Education Institutions. Foreigners applying for distance learning do not need permanent or temporary residence permits (students at the Transport and Telecommunication Institute are asked to appear in person on one occasion only - to defend their final thesis).

Applicants who wish to study in English should present a document certifying their knowledge of English, which is a certificate of the centralized English examination (with a result of not less than 55%). As an attachment to their application, foreign applicants have to attach a document issued by an international testing institution during the last five years that certifies their language proficiency in the relevant study program at least at level B2 or a university certificate of passing the English language entrance examination at least at level B2. The mentioned document is not to be attached if foreigners acquired secondary education or higher education in the language of implementation of the relevant study program, in which case foreign applicants have to submit a certificate issued by the relevant educational institution.

To ensure a higher quality of knowledge of the admitted students, foreign applicants wishing to study in undergraduate programs are required to pass examinations in the specialization subject/s-- English and Maths and / or Physics.

The admission rules set out the document submission procedure, deadlines, competition process, appeal and contesting procedure of the decisions related to admission, the procedure for entering into the study agreement and matriculation, the rights and obligations of the applicant and TSI. The appendices to the admission rules contain precise information about each study program for which enrolment is planned in a given academic year, including admission requirements, documents to be submitted, etc. The website of the TSI contains up-to-date information on the study programs, enrolment period, tuition fees, discounts and scholarships.

The Admission Department offers prospective students consultations on the admission process, including admission requirements, contesting admission results, rights and obligations of the applicants. The Admission Department provides services via e-mail, telephone and face-to-face meetings. Similarly, consultations on admission requirements, for example, entrance examinations and their specifics, are provided by the heads of the study programs, thereby ensuring that applicants are fully informed and prepared for admission to TSI.

TSI announces the admission results as stipulated in the admission rules and organises signing of the study agreements with the successful candidates. After signing of the study agreements and fulfilment of obligations by applicants, TSI ensures the matriculation of these applicants.

In terms of study, Bachelor's and Master's programmes in Computer Science with specialization in Artificial Intelligence are also implemented in a double degree format in cooperation with the University of the West of England Bristol (UWE). In accordance with the terms of the concluded strategic cooperation agreement and the Academic Study Regulations approved by UWE / TSI, which regulates the study process in double degree study programmes, TSI is responsible for the admission of students and their compliance with the admission requirements, which are synchronized between TSI and UWE Bristol.

Opportunities for recognition of previously acquired formal and non-formal education within the study direction

TSI ensures fair recognition of previous education and professional experience so that applicants can apply for studies at later stages. This process is implemented considering the fact that students are mobile both within the higher education system and between education systems.

Recognition of the study results achieved in previous education or professional experience is governed by the procedure *Rules for Recognition of Competences Acquired outside Formal Education or Professional Experience and of Study Results Achieved in Previous Education*" (available at: https://tsi.lv/sites/default/files/editor/Dokumenti/Oficialie_Dokumenti/regulations_on_recognition_of_learning_outcomes_obtained_during_non-formal_education_or_competencies_acquired_during_professional_experience_and_learning_outcomes_achieved_in_previous_education.pdf)

To make a decision on the recognition of knowledge, skills and competences acquired outside formal education or through professional experience and on the recognition of study results achieved in previous education, TSI has established a commission ensuring the involvement of the director of a relevant study program. The establishment of one commission for all thematic areas of education allows for the implementation of a uniform approach throughout the Institute, which prevents from forming different interpretations and ensuring equal treatment of persons.

To have the study results attained in professional experience recognized, in addition to the application, applicants also submit certificates from workplaces and certificates on their previous education. The certificates must indicate both the length of service and detailed job responsibilities.

As a result, a total of 11 cases of professional experiences have been recognised at the University so far, including the recognition of “Production Practice” in the amount of 26 CP for 2 students in the 2nd level professional bachelor programmes “Electronics” and “Robotics” in 2019.

Recognition of the study period for studies at the later stages of studies is regulated by *the TSI Procedure for Starting Studies at Later Stages of Studies* (available at: https://www.tsi.lv/sites/default/files/editor/Dokumenti/Oficialie_Dokumenti/rules_of_procedure_for_starting_studies_at_later_stages.pdf) and t*he Regulations on the Course Comparison Protocol and the Procedure for Preparation of Individual Study Plans*.

2.1.5. Assessment of the methods and procedures for the evaluation of students' achievements, as well as the principles of their selection and the analysis of the compliance of the evaluation methods and procedures with the aims of the study programmes and the needs of the students.

The assessment system of the students' achievements and study results is stipulated in the external laws and regulations: the Law on Higher Education Institutions and the Law on Education, and in several internal regulations: Study Regulation; Rules of Study Procedure; Regulation on Awarding Academic Bachelor's and Master's Degrees; Regulations on Final Examinations; Regulations for Doctoral Studies.

The mentioned documents are available for students in Latvian and English on the TSI website (https://tsi.lv/about-us/official-documents/).

Different study methods and forms are used in the study process. The main criteria for the selection of training methods include the necessity to ensure the acquisition of required information and development of critical attitudes as well as the general need to attain the expected learning outcomes (specific knowledge, skills and competences).

When grading the students' achievements, the following principles of grading, which are set in the national standards of higher education, are observed:

- openness in the grading of knowledge and skills: when commencing a course, students have access to information on the set of requirements necessary for positive grading;
- compulsory grading: students have to obtain positive grading confirming the successful acquisition of the contents of the program, including tests and final examination (test or exam) with 'almost satisfactory' (4 points) or 'passed';
- grading review options: a procedure for reviewing the acquired grade;
- variety of testing types used in grading: different types of testing are used for grading the outcome of the study program acquisition: tests, exercises, case studies, projects, labs etc., described in the methodological materials of the course in the e-learning environment (based on *Moodle LMS)*.

The methods and criteria for assessing the students' achievements and study results are included in the course description of each study course, which is prepared by the course leader. The academic freedom of each lecturer is respected in the implementation of study courses, including the design and implementation of study examinations, considering that teaching and examination methods must be chosen in accordance with the study outcomes assumed to be achieved in the study course. This fact is reflected in the course descriptions. The course description is prepared by the leading lecturer in accordance with the Guidelines for the Preparation of the Study Course Descriptions (approved on 01.02.2022, Order No. 01 - 12.1/ 11, available in the TSI record keeping system Lotus Notes).

Lecturers introduce students to the knowledge assessment criteria and methods in the first lessons. Students can access the description of study courses with the methods and criteria of assessment of learning outcomes in the e-learning environment (also known as TSI LMS (e.tsi.lv)) .

The summative assessment system is used in the evaluation of the students' achievement. A certain weight in the final course assessment is assigned to the assessment of group work, practical work, laboratory work, control work, tests, etc., carried out during the course implementation. The proportion of the grade obtained in the exam in the total course grade may not exceed 20%-50% of the final mark. When an examination is resit, its weighting in the overall course grade or the description of the examination itself may vary. Such an option is described in the course description and the students are introduced to it at the beginning of the course.

The types and criteria of assessment used in the study course are specified in the description of the study course. To obtain the right to take the final examination of the course, students have to meet the requirements specified in the course description (if any). If students have not fulfilled the requirements of the study course, lecturers have the right not to admit these students to the final assessment of this course, be it an examination or test.

The choice of the type of knowledge assessment (written, oral or combined) depends on the specifics of the study course (including learning outcomes) and the lecturer's individual approach to the assessment of students' knowledge.

The grading methods of students' achievements and the assessment of study results are specified in the *Regulations of Study Procedure* (available at: https://tsi.lv/wp-content/uploads/2021/05/studiju-kartibas-noteikumi_en.pdf). The outcomes of program acquisition taking place via final examinations at all levels is graded in a 10-point system, the lowest positive grade being “4”.

If conflict situations arise in the process of passing the examination, upon receiving a request of the student, the dean appoints a commission to resolve this academic conflict. The decision of the commission is final.

In this case, the opportunity to retake the test before a commission appointed by the Dean is offered to the student as an additional opportunity to directly verify the objectivity of the assessment. If the commission also gives a negative assessment, it means that the student will count this course as an academic debt and will have to settle it in accordance with the general conditions for settlement of academic debts.

The procedure by which the student has the right to dispute the assessment of any test or the decision of the examination board in the course of the study process is described in Clause 17 of the Rules of Study Procedures – the Regulations on the Procedure for Submission and Examination of Appeals.

In his/her student e-card, each student has access not only to all information about the course of studies completion - contracts, invoices, study plan for the entire study period, but also to mid-term and final examination grades, which allows the student to control the implementation of the study plan and the achievement of the study results envisaged in the programme.

Studies are completed by a final or state examination, including the defence of the Bachelor's or Master's thesis. Criteria and methods of assessment of final examinations are included in the *Methodological Materials for the Development of the Final Thesis* and in the *Regulation on Awarding Bachelor's and Master's Degrees* (available at: https://tsi.lv/wp-content/uploads/2020/12/nolikums-akademisko-gradu-pieskirsanu-eng.pdf). *Regulations on Final Examinations* (available at: https://tsi.lv/wp-content/uploads/2020/12/final-examinationrules.pdf) regulate the final examination process for awarding academic degrees, professional degrees/professional qualifications in all study programs implemented by TSI. The final examination papers are evaluated by the state/final examination commissions. After the defence of each thesis, a review of the thesis reviewer and an opinion of the supervisor is read. The final grade of the thesis is determined in a closed session of the commission as a result of the discussion based on the assessment of the commission members, taking into account the assessment of the reviewer and the thesis supervisor by a simple majority vote. In the event of a tie, the vote of the chairman of the commission prevails. The member of the commission who is the supervisor of the thesis being evaluated does not vote.

The analysis of students' achievements is carried out twice in the academic year after the end of each semester at the meetings of the faculty, the rector's office and academic meetings.

Attitudes of students towards study courses being attended are evaluated at the end of each semester by conducting an anonymous questionnaire about the quality of studies. The questions of the questionnaire offer to evaluate the following aspects: understandability and content of the lectures, competence and personal characteristics of the teaching staff, level of requirements, possibility to receive a consultation outside the study time, etc. The results obtained are discussed at the relevant departmental meetings, methodological and administrative meetings. Following the results of the meetings, measures aimed at improving the study process are developed.

In accordance with the Procedure for Submission and Review of the Appeal contained in the Study Regulation, the student may contest the assessment of any examination undertaken during the study process or the decision of the examination commission.

The Bachelor and Master programmes in Computer Science are also implemented in a double degree format with the University of the West of England (UWE). According to the terms of the concluded agreement, the evaluation of the courses included in the programmes is organized according to the TSI and the UWE Study Regulations (available on the UWE Bristol website: https://www.uwe.ac.uk/-/media/uwe/documents/about/services/academic-regulations-tsi.pdf), which is described in more detail in the description of the respective programme.

2.1.6. Description and assessment of the academic integrity principles, the mechanisms for compliance with these principles, and the way in which the stakeholders are informed. Specify the plagiarism detection tools used by providing examples of the use of these tools and mechanisms.

The Transport and Telecommunication Institute has developed *the Code of Ethics* (available at: https://www.tsi.lv/sites/default/files/editor/Dokumenti/Oficialie_Dokumenti/ethical_charter.pdf). The Code of Ethics defines the basic principles of ethics and conduct for administrative, scientific, and research staff, as well as students, creating a favourable, respectful and responsible working environment at the Institute. The Code of Ethics includes core principles and standards of conduct to be complied with by students and employees in their attitude to the Institute, their work and in relations with their colleagues, clients and business partners.

The general principles of ethics are the principles of honesty and justice, responsibility and loyalty, respect and collegiality.

Specifically, the TSI Code of Ethics defines basic ethical principles for students:

- Honestly complete the selected program, obtain theoretical and practical knowledge and skills;
- Do not permit a discriminating attitude towards other students or employees, comply with the principles of honest competition, creating constructive dialogue for the settlement of disputes and conflict situations, and respect the opinion of other persons;
- Be honest in study work, do not permit plagiarism and other kinds of fraud;

and for the academic staff:

- Honestly and responsibly perform their work duties;
- Adhere to the respectful culture of mutual relations;
- The academic staff shall serve as an example for adherence to moral norms;
- Do not permit a discriminating attitude towards students and employees;
- Assess the work of students in a timely manner, fairly and in a reasoned manner and to respect the opinion of students;
- Admit errors and shortages made during the study process or assessment of students' work and settle disputes by direct and open negotiations;
- Avoid the imposition of personal likes or dislikes during the assessment of students works;
- Academic staff shall take care to ensure academic and professional honesty, without creating conditions for the manifestation of academic dishonesty, to follow up the development process of students' papers, do not permit plagiarism, copying and other unfair use of intellectual property or fraud;
- Respect the results of individual work of other colleagues and do not use them for personal purposes.

The Ethical Commission is established on the basis of an order which shall assess complaints regarding a failure to comply with the core principles of professional ethics and conduct. The agenda of the Ethics Committee is regulated by Order No. 01-12.1/24 of May 9, 2017.

Students are introduced to the principles of academic integrity, adherence thereto during their studies, and any sanctions for non-compliance with these principles from the beginning of the study process in the first introductory lecture. The Personnel Department introduces employees to the Code, while employees confirm becoming acquainted with the Code with their signature. The Code of Ethics of the Institute is available to all students, employees of the Institute as well as the public on the Institute's webpage.

TSI conducts regular student surveys, and students have an opportunity to express their views anonymously on the professional level of lecturers and on adherence to the Code of Ethics. These results are taken into account when planning the improvement of lecturers' work quality.

TSI acts in accordance with the principles and rules of good faith and responsible conduct described in the *TSI Plagiarism Control Regulations* (available at: https://tsi.lv/wp-content/uploads/2021/05/plagiata-kontroles-noteikumi-proj-mms-eng.pdf). The regulations set out the procedures for identifying plagiarism in the papers of TSI students, including self-plagiarism, and the criteria on the identification of violation and on the applicable sanctions.

For a long time, TSI used the Unified Computer Plagiarism Control System developed by the University of Latvia, which did not allow for full and high-quality checking of all students' papers and final theses for plagiarism, taking into account the rapid increase in the number of students studying and submitting final theses in English. At the beginning of 2020, TSI purchased a new anti-plagiarism program and since the end of May, all TSI faculty members and students have been using Turnitin®, the world's leading tool for correcting papers and preventing plagiarism.

TurnitIn® is integrated into the TSI e-learning system Moodle and provides a full service for submitting, correcting, determining the originality (plagiarism) of content and returning submitted papers. Upon submitting their papers to Moodle, students immediately receive the assessment of the TurnitIn® system on similarities of their papers with other sources.

As of May 2020, all theses of the TSI programs are checked by TurnitIn®, but a year later, after the approval of the new version of the Plagiarism Control Regulations, TSI started to check other papers for plagiarism, including all study course papers, written examinations of study courses and specific tests of study courses.

The Plagiarism Control Regulations set out the procedures for determining the signs of plagiarism in each of these types of tests and course papers and the applicable sanctions and appeal procedures.

For example, in the academic year 2021/2022 the anti-plagiarism check system identified a high level of coincidence (one of the criteria was exceeded, the level of coincidence with one source) in the Bachelor Thesis of a student in the Bachelor Study Programme “Computer Science” with the final thesis of another student, which was also submitted for defence. In accordance with the procedure established in the Plagiarism Control Regulations, both theses were sent to an expert for examination. The expert’s opinion found that the content of the first part (theoretical part) of both theses is very similar, but the practical research sections of the thesis are significantly different, and the expert pointed out that the text of the practical part is original for each student. Since it was not possible to identify the the source (a limitation of the Turnitin system, in case many files are uploaded into the system at the same time), both students were called to the committee meeting in order to provide explanations and find out which student’s work is original. The students explained the situation: one of the students, due to lack of time (a working student), took the theoretical part of the final thesis of another student on a similar topic, in which he changed only the pictures and slightly modified the text so that the text reflected the topic of the work. The student admitted his guilt and apologized to the other student and the committee. The committee made a decision to issue a verbal warning to the student who owns the original thesis about handing over the work to another student, but for the student whose work was found to be plagiarized, taking into account the expert’s opinion, it was recommended to the final examination committee to significantly reduce the mark for the defence of the Bachelor thesis.

Also, in 2022 the Gender Equality Plan (GEP) has been introduced in TSI to define set of commitments and actions that aim to promote gender equality in an organisation through a process of structural change.

2.2. Efficiency of the Internal Quality Assurance System

2.2.1. Assessment of the efficiency of the internal quality assurance system within the study field by specifying the measures undertaken to achieve the aims and outcomes of the study programmes and to ensure continuous improvement, development, and efficient performance of the study field and the relevant study programmes.

The TSI Quality Management System covers the processes of higher education service provision and scientific activities. It has been designed, implemented and certified in accordance with the requirements of the ISO 9001: 2015 standard. The operation of the Quality Management System ensures the quality of the study process and results in all types of studies and in all programs of the Institute as well as the compliance of research and other types of scientific activity with certain requirements.

Study direction management includes the following quality management processes:

P11. Research of consumer demands and satisfaction

P12. Development of educational services

P13. Planning of the study process

P14. Preparation of study subunits

P15. Admission and registration of students

P16. Implementation of the study program

P17. Study attestation.

TTI internal managerial documents, which regulate the quality management processes are presented in Table 1.

Table 1. List of the main documents of the quality management system relevant to the study direction management

Processes (indices)	Title of the relevant guidance document*
P11	Regulations for the Student, Graduate and Employer Questionnaires.
P12	Regulation on Management of the Study Directions and Study Programs. Regulation on Management of Study Courses. Regulation on Teaching and Methodological Activities. Regulation on the Faculty.
P13	Study Regulation. Rules of Study Procedure. Doctoral Study Regulation.
P14	Regulation on the TSI Branch. Procedure for Inviting Foreign Professors for Short-Term Academic and Scientific Activities at TSI.
P15	Admission Rules
P16	Rules of Study Procedure. Regulation on Internship. Regulation on the Organisation of Distance Learning.
P17	Regulations on Final Examination. Regulations on Awarding Academic Degrees and Professional Qualifications.

* See Appendix 2 for availability of documents.

The operations of the TSI quality management system for the quality assurance of study direction products and services include:

- development, implementation and periodic updating of internal guidance documents;
- planning and conducting internal quality audits;
- control over study directions and study program development, implementation and evaluation processes;
- identification, recording and analysis of non-conformities identified during the audits;
- analysis of complaints and recommendations made by students and other stakeholders;
- development, implementation and evaluation of corrective works;
- research of satisfaction by the TSI students, graduates, employers and university staff, analysis of survey data;
- research of the standards and other regulatory requirements in the field of education and quality management, monitoring of changes, conformity assessment;
- preparation of reports on the state and efficiency of the management system and presentation to the rectorate and the board.

The University is in the process of developing the necessary guiding documents based on the

Annual Work Plan of TTI with the chapter “Development of the Normative Base. Quality Management”. In order to improve the study programme, the Regulations on the Management of Study Courses, the Regulations on the Methodological Work of Teaching, the Regulations on the Management of Study Directions and Study Programmes, the Regulations on the Study Direction Council have been developed.

The guiding documents are available to staff and students in the Normative Document Database (in LOTUS) and on the TTI website. Their implementation ensures timely, transparent and efficient evaluation and updating of study programmes and study courses.

As part of the TTI quality management system, quality audits (process inspections) are regularly conducted. The procedure for conducting internal quality audits is described in Table 2.

Table 2. Procedure for Performing Internal Quality Audits (Inspections)

Explanations	Form of recording
1. Decision on the performance of audits: In the decision of the Board or in the instruction of the Chairman of the Board. The decision on the extraordinary audit should include details of the inspection terms, the sub-bodies to be inspected, the objectives of the audit (processes to be audited) and appointment of the head auditor.	Internal Annual Audit Plan; Instruction of the Chairman of the Board
2. When coordinating the audit programme, audit deadlines may be moved at the initiative of the heads of the sub-divisions being audited, if appropriate.	Audit Program
3. In preparation for the audit, the head auditor shall distribute the tasks among the members of the audit team (where such a team has been established). The auditors examine the governing documents regulating the work of the sub-divisions to be audited and formulate a list of questions. These questions are formulated on checklists. The auditors should be familiarised with the procedures for conducting quality audits and the rules for completing checklists in the courses for raising qualification.	Control Sheets
4. Before the audit, the heads of the audited entities should familiarise the staff with the auditors and ensure the cooperation of the staff with the auditors. The auditors must have access to the data pertaining to the processes being audited. If there are any obstacles to the audit, the auditor shall immediately report to the head of the sub-division and, where appropriate, to the chairman of the board.	Entries in the Control Sheets
5. The auditors shall discuss the identified non-conformities with the staff and the head of the structural unit. Non-conformities shall be recorded in the minutes. The corrective actions agreed with the heads of subdivisions shall also be included herein.	Non-Compliance Protocols. Entries in the Non-Conformity Registry (LOTUS)
6. After coordinating the identified non-conformities and planned corrective actions with the auditee, the head auditor shall summarise the work of the auditors' task group and submit it to the chairman of the board not later than one week after the end of the audit.	Annual Report

Explanations	Form of recording
7. The chairman of the board shall discuss the results of the audit with the head auditor and (where appropriate) the members of the board and the heads of the audited subdivisions. Following the outcome of the discussions, the chairman of the board may make changes and additions to the composition and content of corrective actions. These decisions shall take the form of orders from the chairman of the board. 8. All documents relating to the audit shall be forwarded by the chairman of the board to the head of the Quality Management System.	Orders of the chairman of the board, minutes of board meetings
9. The corrective actions and their effectiveness shall be checked in accordance with the Procedure for Handling the Non-Conformity Register.	In the Non-Conformity Register (LOTUS)

The annual plans of internal audits are discussed and approved by the Board. The audit objects include study processes, processes of resource provisioning and management processes of the study fields. The results of the audits are discussed at the meetings of the Rectorate meetings. The found deficiencies and the taken corrective measures are recorded in the Register of Nonconformities (LOTUS).

Based on the results of the audits, the activities of the Councils of Study Areas were improved, the management of study internships was adjusted, and the content of study course materials was adjusted. Errors in study course descriptions have been identified and corrected.

The annual self-evaluations of the study fields and study programmes are carried out in accordance with the Regulations on the Management of Study Fields and Study Programmes. The self-assessment reports are evaluated by independent experts, discussed by the Senate Committee and approved by the Senate. Decisions of the Senate on the approval of self-assessments include plans for improvement of the study programmes, including measures to improve the identified shortcomings. For example, in the last case of self-evaluation of the IT field of study, a decision was taken about the corrections in the content of the study programmes, to ensure the merging of study courses that are small in terms of the number of credit points (increased to 4 CP).

The acceptance and registration of students' applications and complaints is regulated by the Regulations on the Procedure for the Handling of Complaints and Applications. Records of their consideration and decision-making are kept in the Register of Complaints and in students' personnel files. After considering the received complaints, the student service procedures in the Study Department were improved.

The periodic surveys of students, employers and alumni take place in accordance with the Regulation on Surveys of Students, Alumni and Employers. The results of the surveys are discussed at Academic Meetings. As a result of the discussions, the Corrective Work plans are approved based on the survey results.

The criterion for the effectiveness of the quality management system is its compliance with the requirements of the international standard ISO 9001:2015. This is confirmed by TUV Rheinland certification and annual monitoring.

Each year/semester/quarter, the Management Review of the quality management system is discussed at the Board meetings.

2.2.2. Analysis and assessment of the system and the procedures for the development and

review of the study programmes by providing specific examples of the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. If, during the reporting period, new study programmes have been developed within the study field, describe the procedures of their development (including the process of the approval of study programmes).

The procedure for designing, approving, revising and modifying the TSI study programs as well as the responsibilities of the respective employees and structural units are specified in the *Regulation on Management of Study Directions and Study Programs* (available at: https://tsi.lv/wp-content/uploads/2020/12/studiju-virzienu-un-studiju-programmu-nolikums-eng.pdf).The regulation is in line with the laws and regulations in force in the country regarding the licensing of the study programmes and changes to the programmes.

The procedure for the development, assessment, registration and modification of the study course description and course teaching and methodological materials included in study programs are specified in the *Regulation on Management of Study Courses* (available at: https://tsi.lv/sites/default/files/editor/Dokumenti/Oficialie_Dokumenti/study_course_management_regulations.pdf).

Collective management of the study program design and implementation is carried out by the Study Direction Councils (SDC), which operate in accordance with the *Regulation of Study Direction Council* (available at: https://tsi.lv/wp-content/uploads/2020/12/studiju-virziena-padomes-nolikums_eng.pdf). The deans of faculties and heads of study directions are responsible for the SDC organisation.

In conformity with the student-centred education principles, the TSI students are involved in designing study programs, annual assessment and program improvement by acting in the Study Direction Councils, Faculty Councils, Senate Commissions, Senate via filling out the survey questionnaires. Graduates, employers and external experts also express their opinion on the program in surveys.

Supervision over the implementation of the study program and its quality is ensured by the director of the study program by assessing the study process, study results, analysing the results of student surveys, changes in labour market trends and topical issues in the sector and the world. To analyse and summarise the results of the survey of students, graduates and employers and organise the elimination of the identified deficiencies and improvement of the program.

New study programmes are developed in accordance with the TSI development strategy. Their necessity, usefulness and relevance to the development strategy are assessed by several TSI structural units and collegial bodies, including the Study Quality Council, Faculty Council, Rectorate and Senate.

The design, approval and implementation of the study program involves several stages:

- Program development application, which includes justification of the program topicality, summary, and graduates' employment forecast;
- Developing program content, by including the program planning, course descriptions, and independent expertise;
- Preparation, examination and approval of the licensing document package in the Senate;
- Submission of the licensing document package to an agency included in the European Quality Assurance Register for Higher Education, expert visit and receipt of the licence;

- Marketing activities, announcement of admission and student admission;
- Preparation and placement of the study materials in the e-learning environment Moodle in accordance with the *Regulations on Study Course Management*;
- Accreditation of a study program/study direction in an agency listed in the European Quality Assurance Register for Higher Education.

After the accreditation, in accordance with the Rector's order, an annual self-assessment report is prepared for the study programs and study directions, which includes an overview of the activities undertaken for the improvement of the study direction and which is approved by the Senate of the Institute. The task of the annual self-assessment process is to check the preservation of compliance of the study programs and study directions (content and resources) for the accredited study direction; check the validity and permissibility of the changes made in the study program and the respective study plans according to the effective regulations as well as assess the conformity of the study programs with the higher education institution strategy and the requirements for the quality and efficiency of the study programs.

The self-assessment of the study direction and study programs is prepared by the program director and the head of the study direction. Self-assessment reports are reviewed by the Study Council and approved by the Senate.

During the self-assessment of the study programs, proposals and decisions regarding the inclusion of changes in the study program plans and the need to coordinate changes in the study programs with the AIC Study Direction Accreditation Commission are discussed as well as a decision on the usefulness of the program conformity measures, development of new study courses and the modernisation of the existing courses, and provision of resources thereto. These proposals and decisions are discussed and approved by the Senate as recommendations for the changes and development of the study programs.

In order to analyse the study fields and to obtain feedback, TSI conducts the regular surveys. The procedure for organizing surveys in TSI is described in the document *Rules for organizing students', graduates' and employers' surveys(https://tsi.lv/wp-content/uploads/2023/01/regulations-for-organizing-surveys-of-students-graduates-and-employers.pdf)*. The results of the surveys are analysed and included in self-assessment reports.

Progress in the development of the programme "Robotics" licensed under the field of study.

- Taking into account the rapid development of the ICT field in the world, in order to keep up with the global trends and to offer the knowledge about the contemporary technologies to the students, the TSI strategy 2015 - 2020 plans the licensing of a new STEM programme.
- On January 4, 2017, an order was issued on the creation of a working group for the development of the bachelor level study programme "Robotics" in the field of study "Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science" at TSI. The working group includes as experts the representatives of the employers atthe Faculty Council - Maksims Jegorovs, CEO of "Accenture Latvia"; Aleksandrs Ivanovs, President of "Optron" Ltd.: Vladimirs Samoilenko, one of the leading employees of "Siemens Latvia"; Igors Radčenko, leading engineer of the Computer Networks and Technologies Department of Latvenergo; and students of the Faculty.
- On February 16, 2017, the concept and general structure of the programme was reviewed and accepted by the Teaching Methodological Commission. The programme is planned to be developed as a professional bachelor programme "Robotics" with two specializations - industrial robotics and autonomous robots.

- March 2017 - Determination of the necessary laboratory equipment for practical work. Completing the composition of academic staff according to the study courses to be taught in the programme, they can be reached with the possibility of teaching them in Latvian and English.
- Continuing the work on the development of the programme, representatives from ATLANT-TEC, Accenture Latvia, ABB Ltd., EWM AG (Germany), LIKTA association were involved as independent experts.
- On April 27, 2018, the programme was approved at the TSI Senate meeting and a decision was made to submit the package of programme documents for licensing.
- On August 2, 2018, the programme was submitted to AIKA for licensing.

It should be noted that at the time of the development of the "Robotics" program, the Council of Study Directions, which provides collective the development of study programs, so the faculty council, which also included representatives of employers, participated in the evaluation of the future program.

2.2.3. Description of the procedures and/or systems according to which the students are expected to submit complaints and proposals (except for the surveys to be conducted among the students). Specify whether and how the students have access to the information on the possibilities to submit complaints and proposals and how the outcomes of the examination of the complaints and proposals and the improvements of the study field and the relevant study programmes are communicated by providing the respective examples.

The procedure for submitting and reviewing student complaints and proposals is set out in the *TSI Regulations for the Admission and Examination of Student Complaints and Proposals* (available at: https://tsi.lv/wp-content/uploads/2021/07/regulation-on-the-procedure-for-receiving-and-considering-complaints-and-proposals-of-students.pdf) and the requirements for filing and reviewing appeals are additionally prescribed in by the *Rules of Study Procedure* (available at: https://tsi.lv/wp-content/uploads/2021/05/studiju-kartibas-noteikumi_en.pdf).

In accordance with the internal procedure, students may submit complaints and recommendations to the Study Department, which ensures that complaints and recommendations are registered and forwarded to the responsible department and official in accordance with the *Procedure for the Acceptance and Examination of Requests.*

Complaints and recommendations can be submitted by students in person or by e-mail by sending them to the Study Department e-mail or by filling in an electronic form on the TSI Intranet or else by sending them by post.

Complaints and recommendations received by the Study department are registered in the section *Complaints and Recommendations* of the Register of Applications, which is later supplemented with the information on the result of examination of the application and the decision taken. Complaints and recommendations are processed within 7 business days.

The Study department communicates the decision taken in writing to the person submitting the complaint or recommendation (for information) and the appropriate official (for execution). The registered complaints and recommendations are regularly reviewed and analysed by the Quality

Department staff. Where complaints indicate significant deficiencies in the quality assurance system for education services, they are recorded in a register of non-conformities, and the development and implementation of corrective actions is organised in accordance with the rules for maintaining this register.

Immediately after matriculation, Welcome Week events are held for students, during which the students are introduced to the TTI structure, its officials, Student Self-Government, information system, library, regulatory documents and their availability, etc. All Welcome Week informative materials in the form of presentations are permanently available to students in the e-learning environment. These materials also provide links to the TTI regulatory documents and explanations, including the possibility for students to submit complaints and proposals. The document itself, the Regulations on the Procedure for the Reception and Handling of Student Complaints and Proposals is published on the TSI website and is available to the students on a permanent basis: https://tsi.lv/wp-content/uploads/2021/07/regulation-on-the-procedure-for-receiving-and-considering-complaints-and-proposals-of-students.pdf.

TSI has not received many students' complaints because problematic situations are usually handled and resolved via negotiations.

Two complaints were submitted in the 2021/2022 academic year. The complainants were not up to date vaccinated, did not attend face-to-face lectures and the complaint was related to distance learning. The students believed that they could not properly prepare for the laboratory work during the distance studies, but the instructor refused to accept the exam if these laboratory works were not completed. The Programme Director decided in exceptional cases to allow the exam to be taken without completed laboratory work, but an exam committee was established to accept the exam. Both students failed the exam. In order to count this course as mastered, the next time the students had to fulfil all the requirements of the course - complete the laboratory work and pass the exam, which the students also agreed to do.

2.2.4. Provide information on the mechanism for collecting the statistical data, as developed by the higher education institution/ college. Specify the type of data to be collected, the regularity of collection, and the way the information is used to improve the study field. Describe the mechanism for obtaining and providing feedback, including with regard to the work with the students, graduates, and employers.

TSI collects data on general statistical products characterizing the higher education institutions. The obtained information and data are used to find out the strengths and weaknesses of the study process and to improve the programmes implemented in the study field accordingly. The following information and data are collected:

- The number of received applications and matriculated students in the 1st year and senior years by study programme, language of instruction and home country. Based on the admission results, the possible reasons are analysed and changes are made in the marketing activities of the study programme. The information is reviewed at meetings of academic and collegiate bodies, included in self-assessment reports.
- The total number of students, including the student's status (active, inactive), by language of instruction, study programme, study level, study form and types; the number of students who

obtained the degrees and /or qualifications; dropouts and their reasons. The information is reviewed at meetings of academic and collegiate bodies, included in self-assessment reports.

For simple and convenient obtaining of various reports, which characterize the course of the students' studies, the university has developed a special e-resource, which allows the responsible officials to obtain the necessary original reports easily and conveniently. Data collected in this way can be easily used for further processing.

- Analysis of the results of questionnaires on the satisfaction of students and graduates with the implementation of the study programme (content, quality of lecturers' work, objectivity of the evaluation system, availability of the information, career opportunities); analysis of the graduates' employability, which is discussed at the meetings of the academic and collegiate bodies and included in self-assessment reports.
- The results of the final theses of the programmes, the information is examined at the meetings of the academic and collegiate bodies, included in the self-evaluation reports.
- The students' success – the final evaluations of the courses. Student performance indicators are monitored at the faculty level according to the session results, data are collected once a semester. Success statistics are used to clarify the need for possible changes in the study course evaluation system, study course content and teaching in general.
- Analysis of academic staff's work efficiency (assessed in the connection with the election for the academic position, according to the results of surveys, at the end of each academic year the achievements in the scientific research are assessed).
- Analysis of the available study funds and their costs.
- Analysis of TSI core performance indicators, described in more detail in the financial section.

According to the results of the data analysis, the necessary improvements for the implementation of the study programmes and the organisation of the study process are determined.

Feedback analysis

In order to assess the satisfaction of students, graduates and employers with the study results and to take the necessary measures to improve the study programmes, TSI organises surveys. The procedure for organising surveys is described in the Rules for organising surveys for students, graduates and employers (https://tsi.lv/wp-content/uploads/2023/01/regulations-for-organizing-surveys-of-students-graduates-and-employers.pdf).

The students' survey in electronic format with further analysis of the survey data is organised at the university once a year in the beginning of the spring semester in 2 stages:

- *Survey on the students' satisfaction with studies.* The purpose of the survey is to obtain the students' general assessment of the study programme and the study process, for further improvement of the programme, improvement of the quality of the study process and the study environment.
- *Survey for researching the opinions on study courses*. The purpose of the survey is to find out the students' opinion about the content of study courses, including the study practice and coursework, and to get an evaluation of the work of the academic staff.

Taking into account the specifics of the organisation of the distance learning study process, the questions included in the survey questionnaires in the form of distance learning studies are slightly different in the section on the organisation of the study process.

Based on the results of the survey, a corrective action plan is developed, discussed and implemented.

Survey to receive the opinion of foreign students at the beginning of their studies. The purpose of the survey is to find out the satisfaction of the foreign students matriculated in the 1st year with the services of the agents used and the work of the TSI admission commission, in order to develop the recommendations for improving the quality of the admission process based on the received feedback.

A survey to receive the opinion of the TSI graduates about the educational programme. The survey is organized at least once every two years. The purpose of the survey is to find out the opinion about the relevance of the knowledge, skills and competences acquired during the studies to the professional activity, as well as about the plans for continuing the studies.

A survey to receive the employers' opinions on the preparation of TSI graduates. The survey is organized at least once every two years. The purpose of the employers' survey is to find out how employers assess the compliance of the knowledge, skills and competencies acquired by the TSI graduates with the requirements of the labour market. As a form of surveying the employers, not only questionary is used, but also direct interviews, which are conducted by the Corporate Clients Department during meetings with the representatives of various companies, and round table discussions. During these events, the questions are also asked about the employment of the TSI graduates in the specific company and they are asked to assess the relevance of the knowledge and skills, which the graduates have acquired at the university, to the practical activities.

The results of the surveys are compiled by the Academic Quality Assessment Department, and they are available to the Dean of the faculty, programme directors, and the Heads of the relevant structural units.

The results of the surveys are reviewed during the Rectorate, Faculty Councils, Study Direction Councils and are summarised in the annual self-assessment report of the study direction. Thus, the study program with the study courses is updated every year according to the students' assessment. Students' survey results are used by:

- teaching staff: for the assessment of their professional skills and for the enhancement of their study courses;
- study program directors: for the enhancement of the content of study programs and courses;
- deans: for the assessment of performance of the teaching staff and planning activities for the improvement of the professional qualification of the teaching staff,
- rector and academic and scientific vice rector: for determining remuneration of the teaching staff and enhancement of the quality of the studies at the overall level of the Institute.

In recent years, 30-35% of the students complete survey questionnaires.

Following the questionnaire, students are informed of the survey results, impact of their responses, the actions taken and planned and the changes brought about by the recommendations made in the questionnaires. Students receive information during a specially organised general meeting.

According to the point of view of graduates and employers, the training provided by the faculty programmes is generally in line with the labour market requirements.

2.2.5. Specify the websites (e.g., the homepage) on which the information on the study field and the relevant study programmes is published (in all languages in which the study programmes are implemented) by indicating the persons responsible for the compliance of the information available on the website with the information published in the official registers (State Education Information System (VIIS), E-platform).

Full information on the study programs implemented at the Institute is published on the TSI website at www.tsi.lv in accordance with the accreditation pages of the study direction, program licenses and information included in the National Education Information System.

For each program, the name of the program, obtained degree/qualification, program volume in credit points, type and form of studies, language of implementation, program director and contact information, admission requirements, program annotation, learning outcomes, possible career areas, program structure in the form of study courses, tuition fee, graduate references and other program-specific information are listed on the program website.

All information about the programmes on the TSI website is published in the languages of instruction, except for registration, accreditation sheets, certificates, and other documents that are not translated. Information about the programmes in the Latvian and foreign languages: https://tsi.lv/lv/study_programmes/

Information about the programmes in English: https://tsi.lv/study_programmes/

The Director of each study programme is responsible for publishing the study programme information on the website of TSI, and the Academic Quality Assessment Department is responsible for the compliance of the published information with the information available in the official registers (VIIS (State Educational Information System) and E-platform).

All research activities of TSI are administered, supported, recorded and documented by the staff of the Research Administration Department, who compile them in an internal database. In addition, the department is responsible for updating the information in the National Information System on Scientific Activities *sciencelatvia.lv.*

2.3. Resources and Provision of the Study Field

2.3.1. Provide information on the system developed by the higher education institution/ college for determining and redistribution of the financial resources required for the implementation of the study field and the relevant study programmes. Provide data on the available funding for the scientific research and/or artistic creation activities, its sources and its use for the development of the study field.

As a higher education institution with private capital, TSI supports its operations with its own revenues. Own revenues form up to 95–98% of the total financing, with the other financing of up to 2–5% coming from the implementation of various Latvian and EU funded projects (available in the Financial section of the Scientific Activity Report https://tsi.lv/wp-content/uploads/2022/05/2020-scientific-report.pdf).

The main item of expenses is salaries and other personnel expenditure forming up to 65% of the total cost of TSI, but in 2021 this figure reached 73%.

Due to the fact that most of the TSI total funding comes from tuition fees and most of its total costs are staff expenditure, the decrease in the number of students and the decline in staff professionalism and loyalty may have the destabilizing effect on the TSI financial position.

Consequently, TSI, as an institution with private capital, implements various activities and measures aimed at achieving the set objectives persistently and purposefully and carries out planning of its activities, control and analysis of the implementation of the plan.

In accordance with the Financial Management and Accounting Policy, which was approved on 10.12.2020. with the order of the chairman of the board No. 01-20.2/264 (available in the TSI accounting system Lotus), TTI budgeting is carried out both in the short-term (for a calendar year) and in the long-term (up to 5 years), separately creating the budgets of Financial Responsibility Centers. 2 budgeting approaches, top-down and bottom-up, are used in creating the budget, but primarily using the top-down approach in order to be able to determine the priority sectors and areas of activity, as well as to allocate funding according to the strategic vision of TTI development and to determine the work performance indicators for each area of activity.

In accordance with the Financial Management and Accounting Policy, the Engineering Faculty has been designated as a separate Financial Accountability Centre (FAC). A separate budget is established for the faculty based on defined directions of operation in accordance with the TSI strategic vision; monthly reports on budget implementation are submitted to the Dean of the Faculty, and explanations are given on the reasons for significant deviations and risk mitigation. The general budget of the faculty includes direct income and direct expenses. The main source of funding for the faculty and therefore the study program is the revenue obtained from the tuition fees and related supplementary service fees, which are covered by the funds of natural and legal persons. The amount of the tuition fee and additional service fees is reviewed annually, taking into account market trends and cost prices, and is approved by an order of the Board.

Cost price is one of the management tools of an organisation which can be used for the analysis of its operations and decision-making. A finance module has been developed for calculating the cost of TSI study programs, with built-in activity based costing (ABC) that is used to assign cost to each activity (service or process) and allows to precisely determine the cost of the activity. The finance module allows deans not only to receive information about the cost of a program, but also to make planning and forecasts using the conditions of different scenarios. All programs implemented at the faculty are cost-effective. The results of implementation of the study programs indicate that resources used in the program implementation have been necessary and have been used efficiently. (for more details, see programme description, parts 3.3).

An analysis of cost items shows that the major items of expenditure are salaries and taxes, infrastructure, advertising and marketing costs. Salaries and taxes make up 63% to 65% of the costs on average and are highly dependent on the qualifications of the staff involved in the study process. In 2019 and 2020, highly qualified lecturers were invited to teach in the program. The second largest cost item is infrastructure costs, which account for 8-9% of the total cost on average. Infrastructure costs have significantly decreased in recent years as a result of investments in TSI infrastructure and energy efficiency.

The positive financial results of the last years allowed to allocate additional funds to the implementation and development of study programs and for the use of study materials and scientific infrastructure. In 2019, the share of these cost items was 10% of the total costs, and it was planned to further increase the share of these costs. However, in 2020, with the onset of the pandemic, several measures had to be abandoned, thus reducing costs to 4% of total costs.

Since a set of structural changes have been made to reduce the administrative burden and the financial management of resources has been successful, it is important to reduce administrative costs and interest payments.

Every year, the TSI budget allocates funds to promote the research activities of faculties and their lecturers, specifically, to pay for publications and conferences, exchange visits as well as for international cooperation activities and membership fees. The budget for these purposes is planned based on the development and professional growth plans of each faculty and faculty staff.

At the beginning of each academic year, in September, the dean of the Faculty submits a plan for the academic research of the teaching staff to the Research Administration Division, which includes the plan in their budget.

The types, amount and procedure of payment for the scientific activity are specified in *the TSI Remuneration Rules for Academic Staff* (approved on 17 September 2019 in the TSI Senate sitting, protocol No. 01-7/1, available in TSI record-keeping system), defining the following types of separately payable research work for academic staff, such as supervision of doctoral thesis, review of the papers of TSI Scientific Conference's (RelStat/MIP/RatSif) participants, review of abstracts and articles for the TSI *RelStat* conference, publications in journals and conference proceedings included in the cited databases *WoS, SCOPUS* ***, publications in journals and conference proceedings included in the cited databases *ERIH, Engineering Village2, EBSCO****,* review of articles based on the outcomes of the *RelStat* conference (participation with a report), review of articles for the TSI journal *Transport & Telecommunication*, patent registration.

The library budget allocates financial resources to the acquisition of study literature and scientific literature and expansion of library resource funds on the basis of orders submitted by the Financial Responsibility Centres. These orders in turn meet the objectives set out in the development plan of the Financial Responsibility Centres.

Much attention is paid to the possibility of raising additional project funds aimed at increasing the scientific and academic capacity.

- From 2018 to 2021 within the framework of the project "Strengthening the academic staff of Transport and Telecommunication Institute in the areas of strategic specialisation", No. 8.2.2.0/18/A/011, with a total budget of EUR 666 097. 02 there were recruited 9 foreign faculty members (14 in total at the university) to teach study field programmes, who read a total of 27 study courses and prepared the content of 9 study courses for distance learning, as well as allowed 17 faculty members of the study field to participate in internships in the companies of industry in the amount of 200 academic hours, and to improve their knowledge of English.
- From 2017 to 2020 within the framework of the project "Modernisation of STEM study programmes at Transport and Telecommunications Institute" 8.1.1.0/17/I/009, with a total budget of EUR 1246177. 44, there were modernised 3 classrooms by investing in the renovation works and equipment; 2 new laboratories - Industrial Robotics Laboratory and Mobile Robotics Laboratory - were created, and 1 existing laboratory was modernised; practical training facilities and equipment for the needs of STEM programmes were modernised; the IT infrastructure was improved and the library collection was supplemented with electronic literature and printed publications.
- In 2015, within the framework of the project "Development of the Institutional Capacity of Transport and Telecommunication Institute", No. 2DP/2.1.1.3.3.3./15/IPIA/VIAA/006, with a total budget of EUR 113 036, according to the recommendations of the external assessment of science, the TSI development strategy and the research programme were developed, the Institutional Development Plan and the Human Resources Development Plan were elaborated, cooperation between Latvian and foreign scientific institutions, higher education institutions and employers was improved.
- From 2010 to 2013 within the framework of the project "Information and Communication Technologies as a Common Academic Resource at Transport and Telecommunication

Institute” No. 2010/0180/3DP/3.1.2.1.1/09/IPIA/VIAA/023, with ERDF funding of EUR 2.08 million and TSI contribution of EUR 0.37 million, the Centre for Telecommunications, Electronics and Robotics with 11 equipped laboratories were created; thee were also purchased and installed the lifts and the reconstruction and renovation of the TSI building was implemented.

- PostDoc project “Spatiotemporal urban traffic modelling using big data” (1.1.1.2/VIAA/1/16/112)
- PostDoc project “Nontraditional regression models in transport modelling” (1.1.1.2/VIAA/1/16/075)
- PostDoc project „Integrated Model for Energy Generation, Distribution and Management” (1.1.1.2/VIAA/1/16/095)

2.3.2. Provide information on the infrastructure and the material and technical provisions required for the implementation of the study field and the relevant study programmes. Specify whether the required provision is available to the higher education institution/ college, available to the students, and the teaching staff.

The study program in Riga is implemented on the study premises with a total area of 13,567.10 m2, located on 1 Lomonosova Street. Currently, the TSI auditorium fund includes 12 lecture halls, 10 computer classes, and more than 20 classrooms for practical and laboratory classes. The study and research area is 9638 m2, the sports and recreation area is 2879 m2.

The study premises have undergone a modern reconstruction using the Institute funds. From 2011 to 2016, during the TSI project Information and Communication Technologies as a Single Academic Resource at the Transport and Telecommunication Institute (Agreement No. 2010/0180/3DP/ 3.1.2.1.1/09/IPIA/VIAA/023), building construction works were carried out, and the building infrastructure was adapted for persons with functional disabilities: lifts were purchased and installed; the internal and external stairs were adapted for persons with disabilities; sanitation facilities were renovated and adapted for persons with disabilities.

As of January 2017, TSI students have access to a fully renovated and equipped gym that offers classes in a variety of sports. Students can choose sports activities according to their interests as well as practice sports in additional sessions.

During the project *Modernisation of STEM Study Programs at the Transport and Telecommunication Institute*, contract No. 8.1.1.0/17/I/009, classrooms of 656 m^2 on the 2nd floor were renovated (auditorium No. I - 170 seats, No. II - 216 seats and No. III - 170 seats). Renovations included repairs, insulation, heating, improvement of ventilation and air conditioning systems, power and fire protection, acoustic solutions, and furnishing the auditoriums. Outdated servers were also replaced - servers with study data and servers supporting the study process (providing e-mails to students and the distance learning system *Moodle*), the Multimedia Lab was updated (video lectures and other materials for on-site, off-site and distance learning departments were recorded), the Library fund was expanded. In April 2019, the Library’s electronic reading room (72 m^2) with 30 user sites was opened. The e-library has workstations with 15 desktop computers, as well as 15 working sites for personal smart devices. An individual electrical connection is provided for each working site.

Provision of TSI with classrooms in Riga, 1, Lomonosov Street is provided in Appendix 8.

The TSI physical IT infrastructure consists of

- TSI computer network, located in the study blocks in Riga, which are connected with IPsec VPN. More than 500 computers and other network devices are connected to the TSI computer network
- TSI data centre infrastructure located on 1 Lomonosova street in Riga: 25 physical servers, RAID, Hyper-V virtual server infrastructure with more than 25 virtual servers, backup power system, cooling, data backup infrastructure
- IT hardware and systems monitoring system Nagios (Centreon), Zabbix, MS SCCM with more than 500 monitored devices and services
- Computer network security is ensured by PaloAlto's New Generation network screen
- 3CX phone infrastructure maintenance and support for 100 connections
- Video conferencing system for online lectures
- E-mail system maintenance - employees use an Exchange server which offers calendar and contact management and provides a convenient tool to work with electronic mail; students are provided with Office 365 cloud service;
- MS Active Directory-based maintenance of an electronic identity management infrastructure (one username and password for all centrally maintained IT systems)
- Maintenance of a file server
- Maintenance of computerised workstations and computer classrooms (450 computers, 125 printers, scanners and other devices)
- Maintenance of classroom equipment - 35 rooms with stationary equipment, 25 projectors, also including preventive maintenance of the equipment
- Classrooms provide the necessary support for video recordings of the lectures, online lectures and lectures in classrooms with sophisticated multimedia equipment
- Self-service copy/print/scan system
- A software server that enables students to work remotely with the software used by TSI.

An IT support service is available to ensure the uninterrupted availability of IT resources throughout the learning process.

A secure wireless computer network is available in all TSI buildings. Students can connect to a wireless computer network that is protected by the PaloAlto New Generation Firewall.

Virtually all lecture halls are equipped with visual display equipment, and all lecture halls are equipped with high-power stationary video projectors or large television sets. There are 10 computer rooms equipped with computers intended for the study process

TSI offers its students to use *Office 365*, which provides the opportunity to use the full Microsoft Office, OneDrive file storage at no additional cost. While students are studying at TSI, they have access to all the software they need for a successful study process. The student can install the *Microsoft Office* applications - *Word, Excel, PowerPoint, OneNote* - on five computers (*PC* or *Mac*) and five mobile devices (for example, smartphone, laptop and tablet). The student can use *OneDrive* 1 TB for automatic synchronization of devices.

All classrooms are equipped with a student registration system for classes, which allows to automatically register students attending lectures and control attendance.

Laboratory classes take place in the Telecommunications, Electronics and Robotics Centre (TERC), which includes 11 laboratories. In addition, there are available computer labs: classrooms 303 - 306, 505, as well as the CISCO Computer Networking Lab (226), Microsoft and Oracle Academy (227).

The TERC center has laboratories equipped with the state-of-the-art software and technical equipment, which are actively used in both academic and research work. Each laboratory is a complex of modern technical, software and methodical facilities, which enable the highest level of student teaching. TSI laboratories are shown in Appendix 9.

Two research clusters were opened at the Faculty of Engineering in the 2020/2021 academic year: the Data Analysis and Artificial Intelligence Research Cluster (DAAI) (https://tsi.lv/research/research-at-tsi/research-clusters/data-analytics-and-artificial-intelligence-research-cluster/) and the Systems Analysis and Modelling Research Cluster (MADSYS) (https://tsi.lv/research/research-at-tsi/research-clusters/modelling-based-systems-analysis-and-design-madsys/).

In 2021, the Institute of Transport and Telecommunications opened the Innovation and Entrepreneurship Center iDEAHUB, which ensures the implementation of the project “Innovation Grants of the Institute of Transport and Telecommunications for Students” /iDEAHUB (No. 1.1.1.3/21/A/006), providing for activities such as free training and innovation project competition (see Section chapter 4.5 for more details)

2.3.3. Provide information on the system and procedures for the improvement and purchase of the methodological and informative provision. Description and assessment of the availability of the library and the databases to the students (including in digital environment) and their compliance with the needs of the study field by specifying whether the opening times of the library are appropriate for the students, as well as the number/ area of the premises, their suitability for individual studies and research work, the services provided by the library, the available literature for the implementation of the study field, the databases available for the students in the respective field, the statistical data on their use, the procedures for the replenishment of the library stock, as well as the procedures and possibilities for the subscription to the databases.

The main goal of the library is to ensure the availability of the collection, electronic resources and information systems for the university students, staff and every user of the library.

The Library Terms of Use (available at: https://www.tsi.lv/sites/default/files/editor/Dokumenti/Oficialie_Dokumenti/library_term_of_use.pdf) regulate the service and provision of services, determine the duties, rights and responsibilities of the users of the library, the premises, the system and the equipment.

Three qualified employees work in the library: the library manager and two librarians.

Key statistic indicators of the library (year 2021):

- Number of users – 959
- Number of visits – 611
- Number of remote users – 870
- Number of publications (print resources.) – 681
- Number of issues (e-resources) – 3553

The library premises are in good technical and visual condition. The total area of the Library premises is 308 m^2. Of these, the rooms available to users are 117 m^2, storage rooms are 171 m^2. The library's electronic reading room (72 m^2) with 30 user seats is ergonomically designed. The students can independently use its equipment and have access to e-resources for learning and leisure time. The reading room has workstations with 15 stationary computers, as well as 15 workstations for personal devices. Each workplace has an individual electricity connection

The working hours of the library are optimal, they are chosen based on the users' flow measurements and in accordance with the schedule of the study plans, providing services to both full-time and part-time students.

Working hours of the library service:

	Collections	E-reading room
Monday	10.00 - 18.00	8.00 - 21.00
Tuesday	10.00 - 18.00	8.00 - 21.00
Wednesday	10.00 - 19.00	8.00 - 21.00
Thursday	10.00 - 19.00	8.00 - 21.00
Friday	10.00 - 16.00	8.00 - 21.00
Saturday	10.00 - 14.00	8.00 - 17.00

User support and services

The library provides services to the Institute students, academic and general staff, and any user in the country in accordance with the *Regulation on the Use of the Library*.

Basic free library services are available to all library users:

- Providing textbooks for reading at home
- Lending books from scientific collections
- Library and e-library services
- Self-service copying/printing of materials (paid service)
- Interlibrary loan services
- Consultancy on the use of digital resources
- Consultancy on the search for thematic information in electronic resources
- Assigning ISBN/ISSN numbers
- Purchase of books published by TSI (paid service)
- 19-user computers
- Wireless Internet connection.

Provision of information resources

The university library centrally provides the TSI study process and scientific research activity with the quality information resources and services in accordance with the goals and tasks set by the institute.

Collection of the library information resources (2021):

1. Inventory – 29,890 documents, of which:

- books – 25,453 copies, of which 14,146 copies or 56% are intended specifically for the needs of the direction;
- e-books – 2,738 copies, 2,588 copies of which or 95% are intended specifically for the needs of the course. The own collection comprises documents from various publishers and suppliers

of the scientific information. For example: Springer, Tailor&Francis, Elsevier, etc. indicators of the use - see Figure 1;
- periodicals – 1699 copies, of which 1072 copies or 63% are intended specifically for the needs of the direction.

Several IEEE publications are available in the range of the scientific journals:

- *IEEE Aerospace and Electronic Systems*
- *IEEE Communications Magazine*
- *IEEE Computing in Science & Engineering*
- *IEEE Design and Test*
- *IEEE Engineering Management Review*
- *IEEE Network Magazine*
- *IEEE Spektrum*
- *IEEE Transactions on Automation Science and Engineering*
- *IEEE Transactions on Computers*
- *IEEE Transactions on Reliability*
- *IEEE Transactions on Robotics*

2. Subscribed databases (2021)
3. *Academic Complete* e-book database, about 180000 book titles. Contains several collections corresponding to the direction with the following number of books:

- Computer Sciences - 7075 titles;
- Electronics – 363 titles;
- Telecommunications – 212 titles;
- Information systems - this topic features as a subset of Computer Sciences/Technology & Engineering/Business & Economics – 162 titles.

2. *ScienceDirect*. Multidisciplinary database of the publishing house Elsevier. Contains full texts from 4,604 titles of journals published by Elsevier. The number of journal titles corresponding to the topic of the direction:

- Computer science – 266 titles;
- Engineering – 454 titles;
- Materials Science – 314 titles;

3. *SCOPUS* is Elsevier multidisciplinary scientific publication and bibliographic citation information database. In TSI the information from SCOPUS is used to support the scientific and research work.

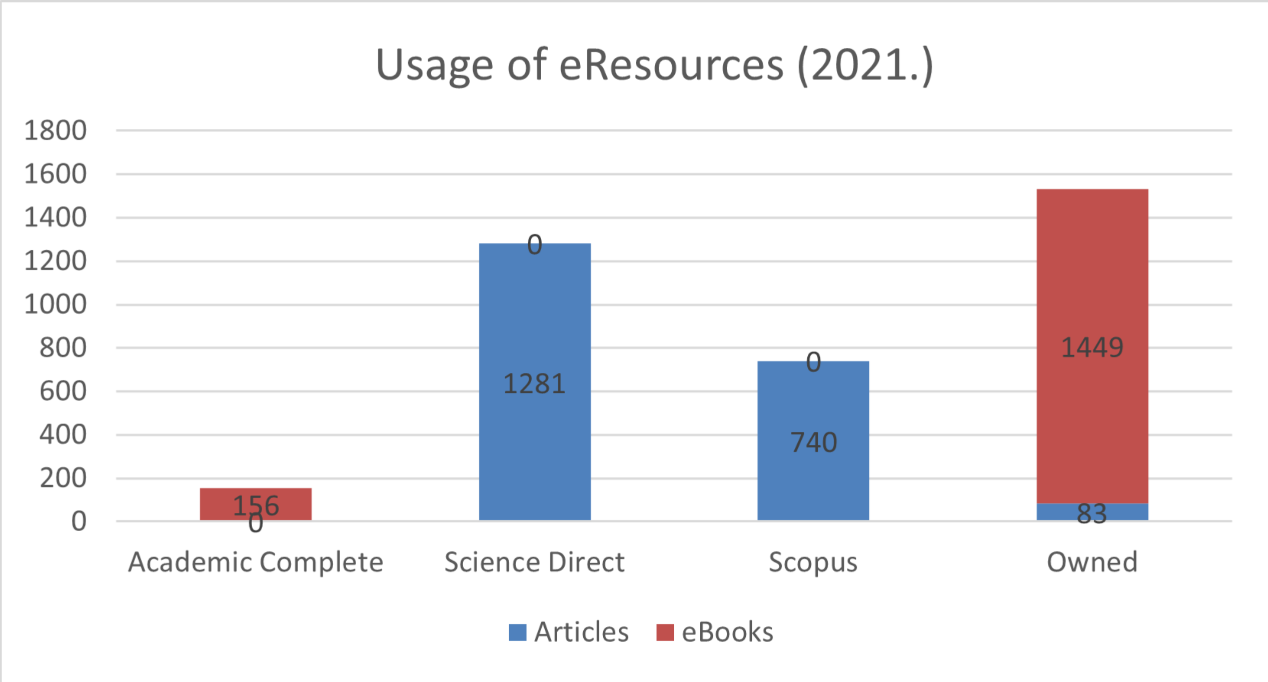


Figure 7. Indicators of the electronic resources use

1. **Provision of accessibility:**

- The library electronic catalogue contains the records of the printed and electronic resources in the collection. Access to the catalogue from the library website https://lib.tsi.lv/;
- The users have the opportunity to access remotely their virtual account and reserve the information resources;
- E-books can be read online or downloaded to the user's device. Books are available in EPUB and PDF formats;
- The database of works published by TSI lecturers has been created and regularly updated at the university https://research.tsi.lv/index.php?option=com_jresearch&view=publicationslist&Itemid=64&lang=en/
- Instructions for using the electronic book collection and electronic resources are posted on the library website;
- It is possible to contact the library staff remotely and to ask questions about the use of electronic books and e-resources;
- In the study course "Introduction to the specialty" all 1st year students are introduced to the use of the library and collection, including the electronic resources;
- The library regularly organises trainings for the academic staff and students to work with the electronic resources, including the foreign lecturers who represent the largest database publishing organisations. Since the beginning of 2020, these classes are held remotely. In total, 13 classes were organized in 2021, which were attended by 71 interested parties.

Principles of creating library collections:

- In cooperation with the TSI Library Council, a collection policy was created, which, in accordance with the TSI Development Strategy, determines the priority collection directions;
- At the beginning of the calendar year, the faculties fill out a uniform format of requests for the purchase of books and e-books, according to which the library purchases and processes the resources;
- Since 2018 requests are also accepted for the purchase of electronic books;
- Regular consultations with the academic staff and TSI management are held regarding the

renewal and addition of the library collection, including electronic resources;
- Every year in October, faculties are invited to review the list of subscribed periodicals and to put forward the proposals for the subscription of periodicals for the next year.
- Information on the latest purchased resources is placed on the TSI library portal and sent out as electronic information to all TSI employees and students;
- Users are regularly offered trials of scientific databases.

2.3.4. Provide a description and assessment of information and communication technology solutions used in the study process (e.g., MOODLE). If the study programmes within the study field are implemented in distance learning, the tools specially adapted for this form of study must also be indicated.

Students and lecturers are already provided with a well-developed IT infrastructure and a virtual study environment.

To submit an application for studies and documents for admission, applicants use the Admission system, which is an Internet portal and is available worldwide. Applicants apply for admission, upload the necessary documents, which are then processed by the department staff. The system is also used to communicate with the applicants.

When an applicant becomes a TSI student, he/she receives a personal username and password to access the TSI information resources. Access to the personal cabinet is via *mans.tsi.lv*, where personal information is available (contact information, information about contracts, finance), schedule of lectures, study plan for the entire study period with the obtained evaluations of the study works and final evaluation of the study courses. This is the primary student resource that links to other TSI resources available to the students.

The e-study environment or Moodle platform is used as a tool for organising the study process in each study course. The mandatory teaching methodology set for each course, is defined in the Study Course Management Regulations; it must be placed on Moodle, and is as follows:

- description of the study course;
- tasks for the independent works planned in the study course;
- samples of independent work (if available);
- self-test tasks, exam questions;
- other learning materials used for independent learning of the study course (lecture materials, presentations, various additional materials, etc.)

In the TSI LMS(e.tsi.lv) environment, learning materials are exchanged and students communicate with the lecturer, individual works and tests are submitted, etc. The students and academic staff can access the internal and external regulatory acts, methodological instructions for the development of the final exam papers, practice programmes and other practice documents, application forms, etc., which are available here; current information about the student life and upcoming events is published here. Environment is available 24 hours a day from anywhere with the internet access.

Big Blue Button, an open-source web conferencing system linked to TSI LMS(e.tsi.lv), is used for the remote classes. Built for online learning, this system supports the real time audio, video, slides, chat, and screen sharing. In addition, instructors can record their lectures and later play back their content to share with the students. On the other hand, the Online Classroom function of the system allows registering the participants of the lecture, and thus gives the opportunity to control the participation of students in the lecture.

It is also possible to access the TSI LMS(e.tsi.lv) system from mobile applications, which expands the possibilities of using this system. A separate enviroment is designed for distance learning students (distant.tsi.lv).

The current schedule of classes and consultations, news and contacts of the TSI structural units and academic staff are also available to students and employees using the mobile application *tsi schedule*. A system that supports this application allow sending the short notifications to the phone, for example, about changes in the lectures timetable.

TSI has a relatively large and modern electronic library, which is available to every student using the address *lib.tsi.lv*. This resource allows accessing not only the electronic books, but also to obtain the information about and order the printed books available in the library.

Administrative information resources available to the TSI employees

The Moodle-based system *e-adm.tsi.lv* is designed to host internal working documents of structural units and to organise the virtual meetings. The academic staff uses it to improve their knowledge, since the materials for pedagogical seminars, projects, etc. are located here.

teacherplan.tsi.lv is a separate resource for the academic staff; the access is provided with a personal username and password. This resource allows planning and tracking the academic workload of lecturers, planning and controlling the scientific activity of the academic staff.

The study course management system *cms.tsi.lv* is used by the academic staff, programme directors and faculty management for organising the work with programmes and study course descriptions.

Intra.tsi.lv is the unified database containing the information on the study programmes, all types of the study plans of each programme and students and students' groups; it is the main work tool for the Study Department.

e-mail system maintenance is an Exchange server, used by the 33employees; it provides calendar and contact management and serves as a convenient tool for working with e-mail; the students are provided with the Office 365 cloud service.

2.3.5. Provide information on the procedures for attracting and/or employing the teaching staff (including the call for vacancies, employment, election procedure, etc.), and the assessment of their transparency.

The teaching staff with high qualifications and the relevant knowledge and competences are involved in the implementation of the study direction and in the achievement of set objectives.

The procedure for application, selection, evaluation and election of the academic staff to the academic positions at TSI is regulated by the "Regulations on the Election of Academic Staff and the Evaluation of their Scientific and Pedagogical Qualifications" (https://tsi.lv/wp-content/uploads/2022/07/nolikums-par-ak.-persona%CC%84la-ieve%CC%84le%CC%84s%CC%8Canu-apstiprinats-senata_eng.pdf).

The number of academic staff positions is determined in accord with the list of positions of a specific faculty and its budget. The planned change in the position list of the academic staff for the next budget year is approved by the dean of the respective faculty. Unplanned changes may be implemented only with the consent of the Board.

The selection/election of the academic staff is carried out in several stages:

- Information on vacancies in the faculty or the need for new vacancies
- Submission of an application to the Personnel Department which is prepared by the dean of the faculty and agreed on with the Vice-Rector for Academic Affairs and the Rector on the need to organize a competition for a vacant academic position
- The dean together with a specialist of the Personnel Department determine the requirements, knowledge and competences that are necessary for the performance of the academic position and that are included in the advertisement.
- The Personnel Department announces the competition by publishing the advertisement, depending on the requirements and the vacancy status, on the TSI website or specialised job advertisement portals (e.g. CV-online).
- The Personnel Department accepts the candidates' application documents and carries out the initial evaluation of the applicants' documents for compliance with the established requirements.
- Depending on the vacancy requirements and status, applicants' pedagogical skills are evaluated by the faculty, for example, by asking candidates to conduct an open lecture after which the dean provides a statement of opinion, a recommendation.
- Evaluation of the provided information and professional abilities of the applicant by an expert nominated by the Senate Competition Commission and the presentation of this evaluation to the members of the Senate Competition Commission
- Voting of the members of the Senate Competition Commission and recommendation to the Senate regarding the election/non-election of the candidate to the academic position
- Elections are held in the Senate, the most suitable candidate is selected and a job offer is made

The competency, professional skills and self-motivation level of potential employee are evaluated during the recruitment process. Since all TSI programmes are also taught in English, and two of the degree programmes are delivered in a double degree format with UWE Bristol, academic staff need very good English language skills.

Competitions for academic and research positions are advertised publicly - on the TSI web page, in the specialised job advertisement portals with which TSI has a contract (CV-online), if necessary, on the portal *Latvijas Vēstnesis*, the European Commission portal *Euraxess*, etc., giving a chance to all the interested parties to apply for employment at TSI within one month of the date of publication of the vacancy. Other recruitment methods, such as disseminating information through social media sites (Facebook, Linkedin, etc.), may be used to attract candidates from specific fields or with a narrow specialisation.

Applicants' application documentation, previous research and pedagogical qualifications and an open lesson, prepared and conducted by the candidate and attended by the students, after which the dean of the faculty provides a statement of opinion, are evaluated.

For the detailed evaluation of the documents submitted by the candidate, one expert is appointed from the TSI academic staff who is competent in the respective field.

During the meeting of the Senate Competition Commission, which assesses the candidate's scientific, pedagogical and organisational competences, the evaluation of experts and the dean of the faculty are heard, and personal interviews are conducted with the candidate. The Commission, by its decision, directs the most suitable candidates to the Senate for election to the academic position.

Within three days of the receipt of the Senate decision on the election of a candidate to an academic position, the Personnel Department informs the candidate on the Senate decision, whereas within five working days the Department prepares the necessary amendments to the agreements for the elected lecturers or concludes the employment agreements.

In the case of the election of a professor or associate professor, a package of documents with an extract of the Senate minutes is handed over to the candidate for its submission to the relevant Council of Professors.

TSI has established a Council of Professors of Transport Engineering. The current composition of the Council of Professors was approved by the Senate on April 12, 2022 (https://tsi.lv/research/excellence/professor-council/). The Council of Professors evaluates the scientific and pedagogical qualifications of professors and associate professors, as well as tenured professors or associate professors, in accordance with the criteria set out in the Regulations of the LR MK No. 129 on February 25, 2021 "The procedure for evaluating the results of scientific and pedagogical qualifications or artistic creativity of the applicant for the position of professor or associate professor and tenured professor or an associate professor".

The qualifications and competences of the academic staff have constantly been developed by the improvement of pedagogical skills, the development of English and professional training in the field.

The knowledge of the national language of the teaching staff is fully in line with Cabinet of Ministers Regulation No. 733 07/07/2009 *Regulations Regarding the Amount of Knowledge of the Official Language and the Procedures for Examination of the Knowledge of the Official Language and the Amount of the State Fee for the Examination of Fluency in the Official Language* and with the level of knowledge specified in Appendix 1 of the Regulations. This requirement does not apply to guest lecturers from abroad who teach courses in the official languages of the European Union. The TSI Personnel Department verifies the state language skills when selecting staff and compiling documents in the preparation process for the academic position elections.

Guest lecturers and external instructors are also invited to teach specific study courses on a contractual basis; their competences are assessed in a similar way to those of the elected academic staff. In order to improve the content of the study programs, foreign visiting lecturers are invited to teach TSI study courses. The procedure for inviting foreign visiting lecturers is stipulated in the *Procedure for Inviting Foreign Visiting Lecturers for Short-Term Academic and Scientific Activities at TSI* (approved on 27/11/2012, Order No. 01-174-V, available in TSI record-keeping system).

TTI developed the publicly available Lecturer's Guide (https://tsi.lv/wp-content/uploads/2022/03/tsi-docetaja-rokasgramata-2021.pdf), which reflects the most important issues that should be known to the person, who starts working at TTI .

TTI fulfills the requirement of the Higher Education Law regarding the number of foreign guest lecturers, the number of foreign guest lecturers in the university has been 8% for the last three years.

The process of attracting and evaluating the academic staff is transparent, efficient, and it is one of the prerequisites for high quality of the study process.

2.3.6. Specify whether there are common procedures for ensuring the qualification of the academic staff members and the work quality in place and provide the respective

assessment thereof. Specify the options for all teaching staff members to improve their qualifications (including the information on the involvement of the teaching staff in different activities, the incentives for their involvement, etc.). Provide the respective examples and specify the way the added value of the possibilities used for the implementation of the study process and the improvement of the study quality is evaluated.

In the Development Strategy 2020-2025 of TSI one of the most important aspects of the development of the study field Personnel is the design of the professional development system for the academic and administrative staff of TSI. The measures for qualification and professional development of academic staff are defined in the Procedures for the organisation of professional development planning for the academic staff of TSI (approved on 15.04.2014, Order No. 01-12.1/35, available in the TSI Records Management System).

The regular evaluation of competences of academic staff and the evaluation process includes the following:

- Preparation of annual action plans for the professional teaching and methodological development of academic staff and their implementation in accordance with the program and TSI senior management decisions
- Planning of the financial resources required for the enhancement of the qualifications of academic staff
- Assessment of the professional growth potential of the academic staff of the faculties and the preparation of proposals on nominating the most promising lecturers
- Compiling individual plans for lecturers and proposals of the dean on the implementation of the required professional development measures during the academic year;
- Organisation of annual academic staff attestations.

The applied forms of professional development of academic staff include preparation and publication of scientific publications in international peer-reviewed journals; participation in international conferences, seminars, projects and experience exchange programmes; mobility activities; participation in scientific conferences organised by TSI (RelStat, MIP, R&T-SiF), participation in methodological seminars for learning new teaching methodologies and pedagogical skills; training/internships in international training centres, foreign universities or scientific institutes, companies in the industry; doctoral studies and elaboration and defence of a doctoral thesis.

In support of the qualification and professional development of academic staff, TSI implements a variety of support measures and provides various motivational tools:

1. Methodological seminars are organized, providing an opportunity to improve one's skills in the fields of university pedagogy, educational technology and educational management. The scheduled seminars are held once or twice a month. Seminars held in the 2021/2022 academic year are as follows: *Advanced assessment methods: performance evaluation rubrics; The new format of the new study course description and the criteria and methods for evaluating the study results of the course; Psychological competence of the academic staff; New developments in library resources (Use of the Catalogue; Subscribed databases - content, use, etc.). Advanced methods of organising tests in LMS Moodle, technical implementation of tests. Moodle tools for organizing the remote group work and interactive test questions. “Breakthrough technology” in software development - new requirements for*

the university graduates (Accenture), etc. In addition, once a month there are seminars organized by UWE for the academic staff, which are mostly dedicated to the improvement of pedagogical skills.

2. When it is possible, the academic staff do internships in companies. In the academic year 2019 - 2020, 27 lecturers (including 16 lecturers involved in the field of the study) did 200 hours of internship in Latvian companies JV “Accenture”, “X Infotech” Ltd., “SAF Tehnika” Ltd., “RoboLogic” Ltd., “International Airport Riga”, LGS, JV “Air Baltic Corporation”, etc. The skills acquired during the internship were used to improve specific study courses.
3. Since TSI has long-term experience in attracting foreign students, the English language skills of academic staff are constantly monitored and the opportunities for improvement are offered. To improve foreign language skills, every 2 years the university usually offers the English language training course. In the academic year 2019/2020 a total of 19 university lecturers, 6 of whom are involved in teaching the programme courses, improved their English language skills in the above-mentioned project No. 8.2.2.0/18/A/011. The next English language training course is planned for the academic year 2022/23.
4. TSI supports and promotes participation of its academic staff in the Latvian and international professional associations, unions and clusters, which ensures a connection with the professional environment. Currently the teaching staff is represented in the following associations: Informatics Europe, Latvian Association of Information and Communication Technology (LIKTA), Latvian Association of Electrical and Electronics Industry (LETERA), Latvian Association of Transport Development and Education , European Conference of Transport Research Institutes (ECTRI), Latvian Simulation Society, Latvian Society of Operation Research, Latvian Aviation Association, Latvian Association of Remotely Piloted Aircraft Systems (LARPAS), Society "Women in Transport" , Latvian Logistics Cluster, Latvian Cluster of Goods Supply Chains, Informatics Europe
5. All lecturers have the opportunity to participate in guest lectures - discussions organized by the university to increase their professional competence, for example, on October 13, 2017, Professor Michael Schenk, the director of the Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF (Magdeburg, Germany), delivered the guest lecture “How can you bring INDUSTRY 4.0 technologies to logistics networks”.
6. TSI supports and encourages participation in scientific and teaching methodological conferences, described in details in criterion 4.4.3. The annual conference *Problems of Modern Education* provides an opportunity for TSI lecturers to share their experience with representatives of Latvian and foreign higher education and research institutions, representatives from businesses and municipalities on all issues of methodological and scientific activities related to the modern educational process which is based on information and communication technologies. Due to the constraints imposed by COVID-19, the conference has not taken place for the last two years.
7. Doctoral studies of the academic staff are supported. During the reporting period, several of the current faculty members of the field of the study have completed their doctoral studies and obtained doctoral degrees: M. Savrasov, I. Pticina, D. Pavlyuk, N. Spiridovska, A. Kraiņukov. A. Vesyoly, O. Zervina, O. Skorobogatova are currently studying for doctoral degrees.
8. Special seminars and science weeks are organised to improve professional competence.

- From 2017 TSI organised a series of open seminars on *Science for Business.*

The first seminar focused on the topic *From Data to the Added Value: Views and Solutions* and was marked by talks of the representatives of *Accenture*, TSI lecturers, doctoral and Master’s students.

The second seminar *Digitalisation in Logistics and Transport* and was attended by outstanding scientists from Latvia and Germany, including Hon. -Prof. Dr.-Ing. Klaus Richter and Dipl.-Vw. Kay Matzner ofthe Fraunhofer Institute for Factory Operation and Automation IFF (Germany).

The third seminar *From Data to the Business Added Value* and was attended by the employees of Deloitte Latvia, who shared their experience with students and academic staff

- In 2017, TSI held an online seminar on Pedagogy for TSI Teaching Staff. A. Pupcevs, president of the Senate of the European Humanities University (Lithuania), delivered a lecture on *Distance Education as a Priority in the Development of a* Modern *University*, which focused on improving the quality of distance education with modern methods and technologies.
- On 11 May 2017, there was a workshop on the *Latest Equipment for Non-destructive Testing Methods for Small Components of Aviation Equipment.* The seminar was attended by an expert working non-destructive testing issues as well as by the representatives of *Olympus* (France) and leading Latvian aviation institutions and companies, including the State Agency *Civil Aviation Agency*, the State Border Guard, cargo airline *RAF-Avia*, aviation spare part import and export company *KS Avia*.
- On 16-20 October 2018, for the first time there was organized a *Science Week* which consisted of several events, such as the seminar *SCI-BI: Digitalisation in Logistics and Transport,* the closing conference of the ALLIANCE project *Sustainable Urban Interchanges: Trends and New Prospects* and the international conference *18th International Multi-Conference Reliability and Statistics in Transportation and Communication (RelStat-2018).*
- On 14-18 January 2019, the Transport and Telecommunication Institute hosted a Digital *Academy*, an intensive educator qualification improvement programe aimed at enhancing the lecturers' digital competencies needed to create online training courses. etc.

9. TSI offer all its teaching staff the opportunity to visit foreign universities within the Erasmus+ program, to conduct classes, attend lectures of foreign academic staff, learn new methods and share experiences. In the academic year 2021/2022, 10 faculty members participated in ERASMUS+ mobility
10. The University supports the participation of the academic staff in projects (see Section 4), and also actively uses the opportunities provided by various projects to increase the competence of the academic staff in various fields:

- Participation in COST Actions, which are mainly oriented towards the professional qualification improvement measures (for researchers, the academic staff, Master and Doctoral students):
    - *COST Action CA 19102 Language In The Human-Machine Era,* - https://tsi.lv/projects/cost-action-ca-19102-language-in-the-human-machine-era/
    - *COST Action CA16222: Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport*, https://tsi.lv/projects/cost-action-ca16222-wider-impacts-and-scenario-evaluation-of-autonomous-and-connected-transport/
    - *COST Action 15221 Advancing effective institutional models towards cohesive teaching, learning, research and writing development*, https://tsi.lv/projects/cost-action-15221-advancing-effective-institutional-models-towards-cohesive-teaching-learning-research-and-writing-development/
    - *COST Action TU1305 Social networks and travel behaviour* ,https://tsi.lv/projects/cost-action-tu1305-social-networks-and-travel-behaviour/
    - *COST Action TU1306: Fostering knowledge about the relationship between Information and Communication Technologies and Public Spaces supported by strategies to improve their use and attractiveness (CYBERPARKS)*, https://tsi.lv/projects/cost-action-tu1306-fostering-knowledge-about-the-relationship-be

tween-information-and-communication-technologies-and-public-spaces-supported-by-strategies-to-improve-their-use-and-attractiveness-cyb/
    - *COST Action TU1208 : Civil Engineering Applications of Ground Penetrating Radar,* https://tsi.lv/projects/cost-action-tu1208-civil-engineering-applications-of-ground-penetrating-radar/
- Within the framework of the project *Enhancing Excellence and Innovation Capacity in Sustainable Transport Interchanges* (ALLIANCE). For two years, in July 2017 and July 2018, TSI hosted a summer school on decision-making methodology, business models for transport terminals, best practices in transport company management, etc. The lecturers, participating in the summer schools and developing their competence, as example D. Pavlyuk, N. Spiridovska, M. Savrasovs, I. Jackiva, J. Tolujevs, I. Pticina un citi.
- In project "Fundamentals of Design Competence for Our Digital Future" (H2020-MSCA-ITN-2020 (Marie Skłodowska-Curie Innovative Training Networks) the network in multidisciplinary field were organized.

The opportunities offered to improve the qualifications of the academic staff have a significant impact on the quality of studies. The knowledge gained during professional development and in-service training, as well as from the research work, is incorporated into the study process, thus improving and enhancing it. The study process is continuously updated with the latest developments in the field - academic staff participate in projects, and the results are used to update the content of the study courses. An important element of the staff development is local and international cooperation, which takes place both in the fields of research and academic work (see criteria 2.4.3, 2.5.1, 2.5.2).

Professors and Associate Professors are re-evaluated after their first election, and their performance is evaluated every two years according to the established criteria for scientific and pedagogical performance (Regulations on the Election of Academic Staff and the Evaluation of their Scientific and Pedagogical Qualifications). The quality assessment of the academic staff is carried out with the help of regular students' surveys, and these assessments are also taken into account in the annual assessment of the academic staff.

In March 2020, TSI conducted an electronic survey of job satisfaction and engagement of employees, including the academic staff. In the survey, employees expressed their views on work content, work environment, communication and development issues. As the survey was successful, in the future such surveys will be conducted on a regular basis. The results of the surveys, taken together with the performance indicators of the planned work, are used to improve the internal communication, management and operational processes of the Institute.

Foreign teaching staff: Biswas Rantu (Integration of Cloud Services), Gabelaia Ioseb (Academic Skills and Critical Thinking), Merchan Emmanuel Alejandro Cruz (Business Skills for the IT Industry, Interdisciplinary Group Project , Robot Details and Mechanisms and Their Design, Kinematics and Dynamics of Robots), Rubens Neil (Big Data) teach only in English in the study programmes for both students who study the programme in English and students who learn in Latvian, taking into account that the university has the right to implement no more than one-fifth of the credit points of the study programme in a foreign language (article 56, paragraph 3 of the Higher Education Law, and paragraph 5.1.2 of the TTI study agreement).

2.3.7. Provide information on the number of the teaching staff members involved in the implementation of the relevant study programmes of the study field, as well as the analysis and assessment of the academic, administrative (if applicable) and research

workload.

The qualification of the academic staff involved in the realisation of the study direction corresponds to the specifics of the study programs and the implementation conditions, as well as the requirements of the regulatory enactments. The academic staff are professionals in their field of science and have proven their competence in research of their respective fields.

In accordance with the Law on Higher Education Institutions, Cabinet of Ministers Regulation No. 445 *Regulations on the Teaching Staff Remuneration, TSI Regulation on the Remuneration of Academic Staff* (approved at the meeting of the TSI Senate on 22/06/2021 and available in the TSI record-keeping system) and the job descriptions for academic positions, the teaching load comprises student education, including teaching, conducting and supervising studies, organizing and supervising classes, tests and examinations; it also incorporates scientific research, including conducting and managing research in the relevant sub-branch of science, managing the doctoral studies and research, participation in conferences, preparation of publications, etc.; it also contains both organizational and methodological activities, including the organization of study activities, development and evaluation of study programs, participation in activities on the enhancement of performance quality of the Institute, training of young scientists and lecturers. All members of the academic staff elected to academic positions carry out academic, scientific, organizational and methodological activities.

According to Cabinet of Ministers Regulation No. 445 and the *TSI Regulation on the Remuneration of Academic Staff,* full-time academic staff are assigned annual workload that includes teaching hours, which is the reflection on the pedagogical activities, whereas the rest of the academic workload comprises scientific, organizational and methodological activities (see the table below). In addition to the workload hours listed in the table, research work is conducted in projects carried out outside main working hours of staff and is separately remunerated.

Table 3. Workload of academic staff

Academic position	Workload in hours (per year)		
	Teaching load	Pārējā mācību slodze	Teaching load
Professor	500	400	900
Associate professor	550	350	900
Assistant professor	600	300	900
Lecturer	650	250	900
Assistant	700	200	900

Depending on the academic position, the relationship between these duties changes.

In 2021, the Institute had 51 lecturers elected to academic positions. Research activities were conducted by 77 internal researchers, expressed in full-time equivalent (FTE) as 31. Of the academic staff, 27 members (professors, associate professors, docents, lecturers) were additionally elected as researchers (leading researchers, researchers, research assistants). The full-time equivalent of scientific activity tends to increase every year, which indicates a more active involvement of academic staff in research. This is also facilitated by the strategy of scientific human resources, which is reflected in the TSI Development Strategy for 2020-2025.

Thirty-one representatives of the elected academic staff participate in the implementation of the study direction, including 9 professors, 3 associate professors, 11 assistant professors and 7 lecturers. The division of their academic and research activities is as follows:

Table 4. Academic and research workload of academic staff

Professor	Number of academic staff	FTE academic activities	FTE research activities
Professor	9	3.32	5.02
Emeritus profesors	1	0.27	0.73
Associate professor	3	1.1	1.88
Assistant professor	11	4.05	2.19
Lecturer	7	2.54	1.21

It is evident that professors and associate professors are more engaged in scientific activities and less in the implementation and management of the study process, whereas assistant professors and lecturers are more involved in teaching.

TSI also emphasizes the importance of promoting the development of academic staff by engaging faculty members in research activities and encouraging them to pursue doctoral studies, the outcome of which is an increase in academic positions. In 2021, 4 associate professors were elected as professors for the first time; in 2020, 4 lecturers were elected as associate professors for the first time, and 4 lecturers were elected as assistant professors; in 2019, 3 lecturers were elected as associate professors for the first time, and 1 lecturer was elected as assistant professor.

Currently, 5 TSI lecturers are studying for a doctoral degree (3 of whom are delivering lectures in the field of study), who will be able to apply for the position of an assistant professor after obtaining a doctoral degree.

Care has also been taken to improve the quality, not just quantity, aspects of performance of research staff. In order to balance academic and research activities, motivate academic and teaching staff to enhance the quality of academic and scientific performance, the Transport and Telecommunication Institute has included a detailed payment system for both academic and scientific activities in its *Regulation on the Remuneration of Academic Staff* (approved at the meeting of the TSI Senate on 22/06/2021 and available in the TSI record-keeping system).

In order to ensure that the knowledge and skills that are taught at the Institute are meaningful and useful on the labour market, in addition to the permanent staff, the Institute recruits the teaching staff who carry out their duties as lecturers on a contractual basis for a fixed period. They include industry experts, lecturers elected at other higher education institutions, etc.

A significant number of the TSI academic staff is working in industry. For example, assistant professor S. Šarkovskis works as a Researcher at Sonarworks DSP Ltd. (field of work - DSP algorithms research and design), J. Kijonoka is a Data Scientist at Accenture Latvia, J. Revzina works as an Engineer at iPro Cybersecurity Ltd. and as an instructor at Cisco Networking Academy, Prof. E.A. Merchan is a Director of Engineering at Robotic Solutions, I. Radchenko is a Network administrator at Latvenergo TEC-1, etc.

Guest lecturers are mainly invited for academic work and less for research. However, they are highly ranked lecturers with specific knowledge or professional experience in their respective areas of specialization, which is why they provide high quality lectures and classroom management

Twenty three members of the academic staff teaching in the program (77%) hold a doctoral degree. Of the invited lecturers, there are 6 persons with a doctoral degree, while the rest have a Master's degree in the respective field.

The teaching staff involved in the implementation of the study direction and the programs, plan their pedagogical load according to the study plan of each semester and academic year.

The professional qualification of the academic staff fully corresponds to the requirements of the implementation of the study programs of the study direction; the competence of the academic staff is attested by:

- qualification of the academic staff, its compliance with the requirements specified in regulatory enactments;
- scientific output, topicality of scientific work and cooperation with scientific institutions in Latvia and abroad;
- professional competence as evidenced by the professional and academic experience; the postgraduate students they have educated; the developed study materials, scientific publications; participation in projects and their management, participation in the development or management of study programs, cooperation with Latvian and foreign higher education institutions; work with foreign students; development of study courses, self-assessment of professional activity, etc.

2.3.8. Assessment of the support available for the students, including the support provided during the study process, as well as career and psychological support by specifying the support to be provided to specific student groups (for instance, students from abroad, part-time students, distance-learning students, students with special needs, etc.).

During the matriculation process, each student receives a handbook with the useful information on how and where to find answers to their questions, who to contact to obtain required information.

TSI technical support is provided by the IT department. A centralised study process and information structure support - *helpdesk* - has been set up to receive applications, process them and give guidance to support staff. Table 5 describes the support staff.

Table 5. Description of support staff

No.	Speciality	Task	Quantity	Notes
1	Operating systems engineer	Support of users, study process, IT services	2	Monday-Friday: from 8:30 a.m. till 8:30 p.m. Saturday: from 8:30 a.m. till 6:00 p.m. Sunday: according to the lecture schedule of module training Applications sent to the email are accepted around the clock.
2	Computer technology engineer	Maintenance of computer hardware	1	
3	Computer systems administrator	Support of IT structure functioning	1	

As the study process at the Institute is also organised for full-time evening groups and part-time off-site sessions, which include Saturday classes or modular form training on Sundays, the *helpdesk* is available on weekday evenings and on weekends.

Questions related to the study process are supported by the Study Department and the Faculty Office, which also provide feedback for communication with students. The working hours of the Study Department are from 8:30 a.m. till 6:30 p.m. on weekdays and from 8:30 a.m. till 4:00 p.m. on Saturdays. Thus, the Study Department is open to both evening students who arrive at the Institute after work and part time students on Saturdays.

TSI students can apply for tuition fee discounts. Discounts are granted to students for good and excellent progress, active participation in the Student Council, scientific activities and other criteria.

All TSI students are provided with the opportunity and support to become a member of iDEAHUB and get involved in the implementation of the innovations and projects. iDEAHUB is described in more detail in the specification of criterion 2.4.5.

The Association *Apeirons* has recognised TSI as an organisation friendly for people with disabilities. This has been achieved by adapting the building and study rooms for persons with disabilities (see Part II of Section 3.2). Heads of departments and teaching staff take an individual approach to such students in each situation in the study process. Although the lift is specially adapted, it is often lecturers who go to the student to provide individual consultation or to administer course tests in the ground floor hall.

TSI pays special attention to foreign students. Already at the time of enrolment, the prospective student is offered the opportunity to complete a questionnaire in the electronic system *Admission* that includes questions about whether the student will need to be picked up at the airport and whether he or she will need to be provided with a hotel room with “yes” and “no” as the possible answers. TSI does not have its own hotel, but it has concluded cooperation agreements with several hotels (SIA RIGAAPARTMENT.COM, AS 1Home Group, SIA DODO Hotels) guaranteeing the accommodation for TSI foreign students. Foreign students are provided with the addresses and contact information of these hotels. At the airport, students are welcomed by a TSI student - volunteer. TSI students are entitled to a tuition fee discount for performing such duties.

The organisation of work with foreign students at TSI is the responsibility of the Foreign Student Coordinator, whose responsibility it is to give advice on the study process organisation, behavioural and ethical issues at TSI, entry and accommodation in Latvia (places of residence, hotels, shops, pharmacies, medical institutions, the Office of Citizenship and Migration Affairs, etc.); to organise the integration of foreign students into the TSI study process and student life; to provide communication between TSI administration, departments, the Student Council and national regulatory authorities in order to offer support to foreign students to successfully complete their studies at TSI; together with the assistants of the deans of the faculties and the lecturers, to control the progress of the study process of foreign students (including attendance of classes, control of the study performance); to provide assistance to foreign students in the organisation of their compulsory internship (finding a place of internship, internship applications, preparing and registering an internship agreement, etc.), etc.

The first week of the semester is devoted to the adaptation of local/foreign students, when they are introduced to the structure of TSI, departments and staff (dean and assistant dean), academic culture, information about available IT resources, library, and a guided tour of the capital.

The TSI Corporate Clients Department, which oversees an information database about companies that provide internship opportunities, offers students both internships and information about the latest job offers. The latest job offers are posted and available to students in the TSI e-learning environment *Moodle.* Each spring, the TSI Corporate Clients Department organises Career Days for TSI students, including guest lectures by professionals from various disciplines on successful integration into the labour market, news and current affairs in IT, logistics, and aviation, and the aspiring entrepreneurs are given the opportunity to listen to tips for starting their own business.

Two positions of the Study Process Organisation Specialist have been created in the Study Department for the organization and support of work of distance learning. These specialists implement all types of cooperation with distance learning students, ensuring students' access to teaching and methodical materials of distance learning study courses, and advising and assisting students during their studies to solve organizational, technical and content-related issues, including adjusting the deadlines for submitting the current assignments according to the students' needs , and taking into account the justifying reasons.

The Digitization and Innovation Learning Centre is responsible for the development and deployment of teaching methodological materials for distance learning study courses on the platforms of the TSI Learning Management System.

All the TSI students are provided with the opportunity and support to become a member of iDEAHUB and to be involved in the implementation of innovations and projects. iDEAHUB is described in more detail in Section 4.5.

2.4. Scientific Research and Artistic Creation

2.4.1. Description and assessment of the fields of scientific research and/or artistic creation in the study field, their compliance with the aims of the higher education institution/ college and the study field, and the development level of scientific research

and artistic creation (provide a separate description of the role of the doctoral study programmes, if applicable).

Transport and Telecommunication Institute (TSI) operates in research domains according to the TSI Strategy and Research Program 2015. The goal of the research strategy is to create an environment of scientific and educational services that ensures the excellence of research and academic staff and the realization of research development potential in TSI's strategic research directions.

The research program of the Transport and Telecommunication Institute is main background for activities within the frame of PhD study program and defines 3 strategic research areas: Information and communication technologies (ICT/Telematics), Smart solutions in transport and logistics on the base of ICT technologies, and digital society and economy. All research directions and subtopics correspond to the accredited direction and could be seen in Figure below.

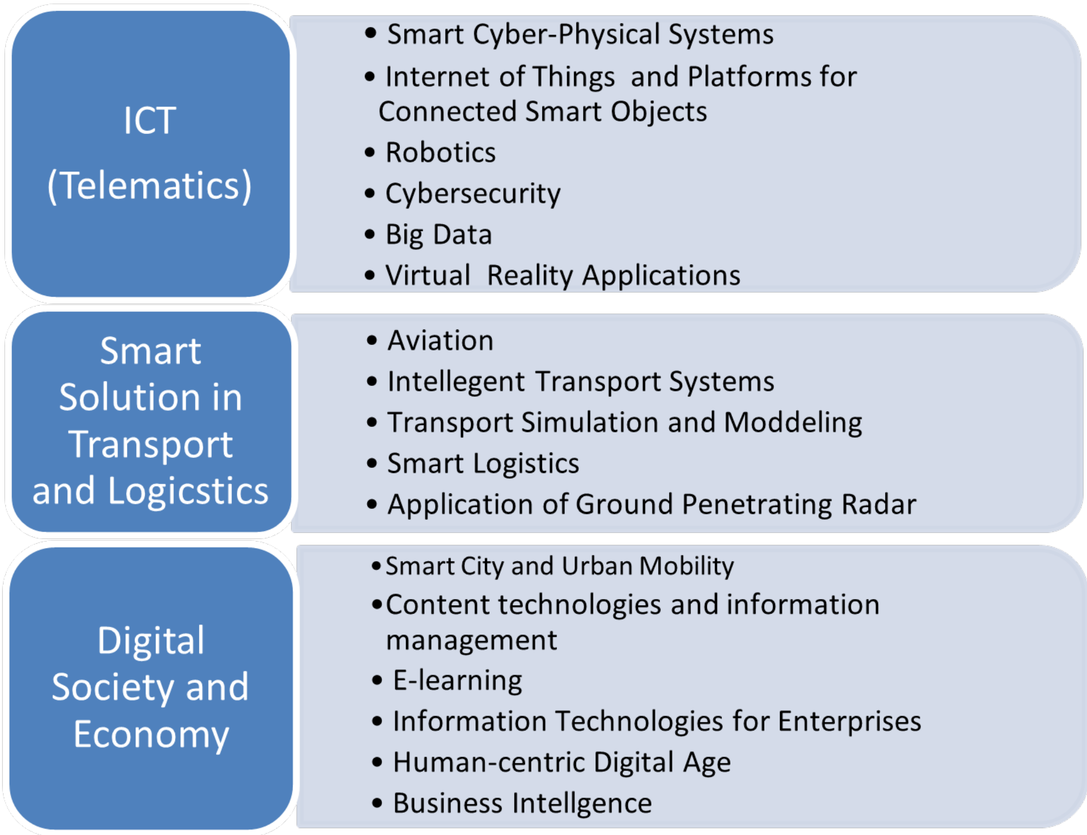


Fig. 8. TSI research direction

The main directions of PhD research activities are carried out within the frame of TSI research strategy and grouped into 6 strategic initiatives and the roadmaps:

1. Improving the positions in research in the fields of TSI research interest.
2. Integration of TSI into the global research and educational system through leading research, information and learning technologies.
3. Creating a novel human resource system and forming a highly professional research staff.
4. Development of strategic communications and achieving high recognition of TSI nationally and globally.
5. Development of the innovation ecosystem to support the growth potential of TSI in knowledge and technology transfer.

6. Transformation and development of the TSI management system based on the principles of a research and business-oriented university.

The three core pillars of PhD research activities within the frame of doctoral study program:

Pillar #1. Information and Communication Technologies (ICT) or Telematics. The main direction of research activities are:

- Smart Cyber-Physical Systems (CPS)
- Internet of Things and Platforms for Connected Smart Objects
- Robotics (multi-disciplinary and innovation activities like technology transfer via use-cases and industry-academia cross fertilisation mechanisms)
- Cybersecurity (Security-by-design for end-to-end security and Cryptography)
- Big Data where activities contribute to the challenge by addressing the fundamental research problems related to the scalability and responsiveness of analytics capabilities (such as data mining and visualization).

Pillar #2. Smart Solutions in Transport and Logistics with main direction of research activities:

- Aviation where research covers condition-based health management; autonomous, intelligent and evolving systems (e.g. Remotely Piloted and Unmanned Aerial Vehicle Systems for monitoring of critical infrastructure) and robust, cost-efficient solutions for the whole life-cycle, based on novel methodologies and technologies towards improving the safety of the air transport system.
- Intelligent Transport Systems provides the key to achieving the vision of seamless transport both in passenger and in goods transport markets on the base of ICT use
- Transport Simulation and Modelling
- Smart Logistics.
- Applications of Ground Penetrating Radar (GPR).

Pillar #3. Digital Society and Economy and research activities are:

- Smart City and Urban Mobility
- E-Learning.
- Content technologies and information management.
- Information Technologies for Enterprises.
- Human-centric Digital Age.
- Business intelligence

Mentioned above research fields tend to be more interdisciplinary and TSI increases the shift from monodisciplinary PhD research practices towards interdisciplinary approaches and improve the support towards stimulating and conducting the multidisciplinary research.

For instance, it is provided through PostDoc researchers, visiting researchers, invited professors, etc. These changes indicate increased interest in collaboration activities, often linked to special funding and stakeholder engagement. For becoming a more significant research player on the EU level, TSI puts special attention on international collaboration. One of the approaches is to increase TSI participation in international-level projects and establish research consortiums with leading European research establishments.

Study direction overall goal is to provide students with a sustainable, high-quality education in the field of engineering, ensuring competitive career development in the Latvian and international labor market and preparing internationally recognized, highly qualified research and academic staff in the field of ICT, telematics and logistics.

TSI research activities are critical to ability to produce graduates who can address the industrial demands of the 4th industrial revolution and its impact on industries, markets and society, including PhD students.

Apart from the national science, technology and innovation development policy (point 1.3.), TSI in its planning and activities relies also on cornerstone document: “Smart Specialisation Strategy (RIS3)”: Specifically, two objectives (“strengthening research, technological development and innovation” and “enhancing access to and use of quality of ICT”) informs Strategy. TSI covers objectives in its research by addressing the ICT, smart materials and smart energetics specialisations (three areas of the RIS3).

Several priorities set by the Ministry - guide TSI planning and evaluation procedures. Priority 1 “effective high added values product development” is covered by the projects and research of Laboratories in the field of robotics, IT and IS. Priority 2 “search for new product/service development” is covered by successful business projects with the private sector, including innovative software and technologies in aerospace industry and priority 3 “energy efficiency” had been addressed in several patents obtained (related to wind power) and PostDoc projects, as example by Dr.sc.ing. Tatjana Endrjukaite. Priority 4 “contemporary standard-compliant ICT system” is covered by projects run by the TSI faculties and Research Administration department (e.g. iSecret, Learn_IT projects). TSI addresses priority 5 through close collaboration with numerous industry representative from ICT, transport and logistics field.

Furthermore, in lines of action set by the RIS3, TSI:

- Integrates education, science, technology development, innovation and business by creating continuity between each of these areas of work: education process involves research and collaboration with industries, research in interlinked with technology development and innovation commercialisation, while business activities are based on educational and research capacities of the TSI.
- Strengthens the innovation capacity of the national economy by establishing mutually beneficial partnerships between academic and non-academic stakeholders.

Research infrastructure of TSI is under direct supervision by Vice-Rector for research and academia and faculties. The core of research infrastructure is concentrated around TSI Telecommunications, electronics and robotics Center (TERC), which unites 11 labs: Laboratory of Industrial Robots, Laboratory of Mobile Robots, Laboratory of Physics and Electrical Machines, Laboratory of Modelling of Electronic Systems, Laboratory of Embedded Systems and Digital Signal Processing, Laboratory of Industrial Automation, Laboratory of Subsurface Radiolocation, Laboratory of Robotics and Students’ Research Work, Laboratory of Designing and Prototyping, Laboratory of Telecommunications and Electro-Optical Systems, Laboratory of Electronics. All listed labs are equipped by the modern devices and software, which supports academic and research process. More than 1000 units of equipment and software is available for researchers, students and academic staff.

In addition to TERC’s labs TSI is operating:

- SimLab (Applied Simulation Laboratory) which is supporting research in the area of complex systems analysis and simulation. Laboratory has more than 100 licenses of the software tools, including unique software for traffic flow, business-processes, logistic-process, manufacturing simulation (as example PTV VISSIM, VISUM etc.) and provides the consulting services to the local private and public sector. For the last 6 years SimLab staff has completed more than 15 projects.
- Image Processing, Biometry & Automated Border Control Systems (IPB & ABC) lab was

developed in cooperation with local business entity “XInfoThech” Ltd. laboratory provides the research related with image processing, biometry, signal processing etc, also team of lab organizes the competition of research works among TSI students in annual bases.

- Laboratory for Modelling Machinery Mechanisms and Materials (4M) conducts applied research in the field of transport and mechanical engineering. The main activities are related to structural, computational and strength, reliability-diagnostic and hydro-gas dynamic modelling.
- DevLab (Application and Information Systems Development Laboratory) is another lab dealing with development of the software solution with cutting-edge technologies. The lab intensively involves students of different level and is active participant of the applied research.

TSI supports “open-access” policy and provides share of its equipment and software. TSI is a part of the UseScience project which is targeted on equipment’s sharing among research and academic entities.

As a member of association European Conference of Transport Research Institutes (ECTRI), TSI resources are included into global transport research sharing Database "Soft Research Infrastructures" and TSI researchers could use the resources more ECTRI members (27 EU research Institutes) https://www.ectri.org/about-ectri/members/. In addition, TSI students academic and research staff has access to electronic library of TSI, which provides journals, conference proceedings, books and text books in electronic form. Library provides possibility to use international electronic databases: “Knovel”; EBSCO, “Academic Complete”; OAPEN-Library; DOAJ; PKP; WorldBank; VersitaOpen etc.

All research activities of TSI are administrated, supported, recorded and documented by the staff of Research Administration Department and aggregated in internal database. Additionally, Research Administration Department is responsible for information provision for sciencelatvia.lv (national science system).

Academic and Research staff, as well as doctoral students are involved into research through participation in programs: European Research and Innovation Programm (HORIZON 2020), European Regional Development Fund (ERDF), COST Actions, ERASMUS+, InterReg, National Development Found projects etc.

2.4.2. The relation between scientific research and/or artistic creation and the study process, including the description and assessment of the use of the outcomes in the study process.

Scientific research activity is an integral part of the study process. The connection of the research with the study process is characterised by the scientific research activity of lecturers, which creates the prerequisites for the improvement and updating the content of the study courses, preparing for lectures, developing practical tasks, topics for seminars, project work and final theses, etc., as well as for developing the students’ research skills.

Students and teaching staff of TSI have access to the equipment and special software purchased for scientific research activities. The facilities of the laboratory are actively used by students for the development of their final theses, as well as for the needs of Bachelors, Masters and Doctoral students of the TSI.

Scientific research at TSI is related to the study process at all study levels. This is especially applicable to the study process at Master and Doctoral level. The study plans for the Bachelor level programs include study courses oriented towards the project activities, which allow students already at the undergraduate level to be involved in scientific projects and applied research projects.

The advantage of this approach is related to the possibility of immediate use of the theoretical knowledge in practice, which enriches the content of the study course and makes it possible to move from the classical teaching approach to the learning-by-doing approach. Students of all levels are introduced to the projects implemented at the university.

For example, 3 students (1 from the “Robotics” programme, 2 from the “Computer Sciences” program) were involved in the implementation of the project “Development of the slot system for multiplex IHC staining” project. In addition, the students are provided with the opportunity to obtain funding for the implementation of their projects through IDEAHUB activities. In this case, the project was successfully implemented in the iDEAHUB, and students received the opportunity to turn the developed innovations into the credit points, which, in turn, can be recognized and included in the study plan in accordance with the rules set by TSI.

For example, in 2022, one of the implemented projects involved a team of students (2 students from the “Robotics” program and 1 from the “Electronics” program) has been successful and the students received the credit points as for a block of free electives courses. The results of the projects and the students’ innovation projects are often promoted at events of various levels, for example at an annual event, the Scientists’ Night. At the event of the Night of Scientists in 2022, a project developed as a part of the Bachelor thesis on the developed robot teacher was demonstrated. The results of the projects are actively disseminated through the Delfi Campus initiative.

Most of the faculty members involved in the study area are also active researchers and scientists who participate in the projects and actively publish their research in journals and participate in conferences. In their courses, they both use examples and demonstrations from the projects and research, and offer students work themes related to their areas of expertise. For example, the course “Intelligent Data Processing”, in which Professor I. Jackiva not only shares her experience and implemented projects, but also some topics in study course are taught by the Doctoral students whose dissertation topics are closely related to the topics covered in the “Data Mining” course.

In the study course “Information Systems and Technologies”, one of the topics dealing with the ethical issues of artificial intelligence is taught by Aleksejs Veselijs, the doctoral student of professor Mihails Savrasovs. In the study course “Computer Vision and Image Processing” professor Aleksandrs Grakovskis shares his experience in implementing the research projects in which computer vision technologies were applied to demonstrate the details of the application of the technology. Professor Igors Kabaškins applies widely the results of the “Intelligent Transport and Transport Management” study module (INTELTRANS) in his doctoral courses.

Undergraduate study programmes also include the study courses in which the lecturers use the implemented projects as examples of situational analysis. For example, in the study course “Systems Analysis and Modelling”, a number of applied research results were demonstrated and discussed with students during the course. Professor Boris Mishnev actively integrates his research results into the study courses at both Bachelor and Master levels, for example, from the project “Implementation of Software Engineering Competence Remote Evaluation for Master Programme Graduates (ISECRET)”.

Students of Master and Doctoral level studies are involved in the research cluster activities: the

Data Analysis and Artificial Intelligence Research Cluster; the Systems Analysis and Modelling (MADSYS) Cluster.

TSI organises the student scientific conference “Science and Technology - A Step into the Future”, where students have the opportunity to participate and to present the results of their research work. The conferences are held twice a year, in December and April. It is compulsory for the students of all Master study programmes implemented at TSI to present their work at the conference before the final examination. The conference is also attended by students of Bachelor level programs, young scientists, doctoral students and students from other universities. Special sessions are organised at the conference where students of secondary school present their research projects.

Participation in COST actions, which often involve Doctoral students and Masters students, provides both the opportunity to get acquainted with the cutting-edge research and to participate in summer and winter schools organised by COST Action project partners. For example, COST Action CA 19102 “Language in the Human-Machine Era” was attended by Doctoral student Olga Zervina, COST Action CA 16222 “Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport” by Doctoral student Ilja Džeksons, COST Action TU 1208 “Civil Engineering Applications of Ground Penetrating Radar” by Doctoral student Aleksandrs Kraiņukovs.

The scientific research in the field of study at TSI is aligned with the study process, which indicates its compliance with the development goals of the field of the study. The mentioned different types of activities applied during the study process ensure the link between scientific and applied research and the study process.

2.4.3. Description and assessment of the international cooperation in the field of scientific research and/or artistic creation by specifying any joint projects, researches, etc. Specify those study programmes, which benefit from this cooperation. Specify the future plans for the development of international cooperation in the field of scientific research and/or artistic creation.

For the development of the study direction, international cooperation is an important and indispensable condition, since it ensures the continuous exchange of knowledge and practices that are necessary in science-intensive and technological fields to always remain in the field of advanced competencies, that arise around the world; and disseminate this knowledge to students, as well as develop own competences and innovations.

As one of the instruments of international cooperation - TSI implements academic, research staff, and student mobility activities. Cooperation agreements concluded by TSI with foreign scientific institutions are in Appendix 16.

Most of the mentioned partners are actively involved in research and applied projects, which is another most important domain for international collaboration. For such cooperation are used programs like Horizon2020, Interreg, ERASMUS +, COST, and other cofounding frameworks.

COST actions usually impact master and PhD level students (master programs ComputerScience, Computer engineering, Management of Information Systems, Telematics and logistics) and young teaching staff, as using COST action is possible to participate in summer schools and regular meetings with fruitful and rich discussions. Usually, the study program director (master level) or PhD supervisor is recommended to students or young teaching staff to participate in such projects.

In this case, the primary impact is the ability to raise the qualification and new knowledge sharing. As an example, in the frame of COST Action CA16222: Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport one master level and two PhD students. In the frame of ERASMUS + usually, TSI with partners develop academic, methodological, and organisational activities. Usually, such collaboration project results are new study courses (or course parts), which TSI adopt for its own study programs (TSI master and bachelor level study program ComputerScience, ComputerEngineering, Robotics). For example the project *Implementation of Software Engineering Competence Remote Evaluation for Master Program Graduates* (iSecret) has resulted in an effective experimental framework for defining and evaluating learning outcomes in master's degree programmes in the ICT field, which were used by TTI lecturers to develop their competencies. One more example is “Learning with ICT use (LEARN IT)” project. Collaboration with partners within the project gave a possibility to develop LearnIT lab. The new lab allowed to test students individual study preferences (for example how frequently students need to take a break during the study). In the mentioned project students from the study program ComputerScience took part.

By participating in joint research projects within the framework of programs financed by EU funds, academic and research staff of study programs provide the opportunity to achieve new knowledge and skills, promote and develop new innovative ideas and find prospective collaboration for them, as well as promote the development of knowledge and best practices of foreign partners for the implementation of TSI initiatives as well in Latvia.

An example of international cooperation can be the ePIcenter – “Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer” project (H2020 program), in which TSI and the staff of study direction participate: the project consortium includes such representatives of the academic sector, scientific organizations, and industry representatives as: Port of Antwerpen; DHL; Stena; Panasonic, and others. Research staff of study direction develop working packages and tasks in frame of the project realization, disseminate common research outputs and cooperate with international partners to achieve planned results. In the frame of such projects, TSI usually develop the partnership network to develop research activity and at the same time to involve PhD level students. In this project, one PhD student is involved and develops his research idea in the frame of the project, as collaboration with partners gave him the ability to receive the necessary data.

Another example of international cooperation – development of innovative solutions for the industry: project TONES, the development of the immunochemistry automated multiplex staining system. In the frame of the development, TSI cooperates with HistoOne AB, a spin-off of the Uppsala University. This project is ultimate multidisciplinary: top-level experts from HistoOne AB and Uppsala University ensure expertise in histopathology, biotechnology, unique solution architecture, usability, and workflows, as well as business logic and processes, while experts and students of study direction ensure software engineering, robotics, mechatronics, electronics, and algorithms development.

The collaboration in the frame of the project gave a possibility to involve students (study programs Robotics, bachelor and master level study program Computer Science). Also, the completed project led to a new patent (patent pending). The project gave a possibility to the students to develop their own competencies. TSI believe that such collaboration (applied research) gives the ability to attract young researchers and to enrich the study programs with a learning-by-doing approach.

Overall, it should be stated that collaboration in the framework of projects plays a significant role for TSI in attracting young researchers and students; and in developing own resources. The list of projects in which the study direction staff is involved is given in Appendix 13.

Research activities of the academic staff and students are facilitated by international scientific conferences, methodological conferences and forums organised by TSI, the main ones being: The international conference Reliability and Statistics in Transportation and Communications (RelStat) has been organized by TSI for 20 years. The aim of the conference is to provide an international forum for scientists and professionals in academia, industry and government to focus on the latest research findings, present and discuss their ideas, theories, technologies, systems, tools, applications, work progress and experience in all theoretical and practical issues emerging in transport, information and communication technologies. For the fourth year in a row, selected articles from the RelStat conference have been published in the conference special edition, Springer Lecture Notes in Networks and Systems (indexed in SCOPUS). https://tsi.lv/wp-content/uploads/2020/10/relstat-2020_abstracts_v3.pdf.

Collaboration in the frame of the conference gives the ability to promote Latvia and TSI as serious research and academic partner, which gives a possibility to develop a new project and attract leading researchers and academic staff. For students and staff, the conference is able o discuss research and academic questions. Usually, PhD level students participate in the conference with presentations (study program Telematics and Logistics), also for master level students it is recommended to attend the conference. Most of the study direction academic staff participates in the conference and presents the research results.

TSI publishes the following internationally cited journals: Transport and Telecommunication is the TSI indexed and peer-reviewed scientific research journal, ISSN 1407-6160, ISSN 1407-6179. Articles published in the journal Transport and Telecommunication include are included in the following databases: SCOPUS (from 2008, Vol. 9, No. 1), Elsevier Database; Web of Science - Emerging Sources Citation Index, Engineering Village, De Gruyter Open; The Summon; Transportation Research Board; ProQuest; ProQuest Engineering Journals; ProQuest Illustrata: Technology; ProQuest SciTech Journals; ProQuest Technology Journals; CNKI Scholar (China National Knowledge Infrastructure); EBSCO Discovery Service; Google Scholar; Primo Central (ExLibris); SCImago (SJR), and many other scientific databases

TSI researchers and leading academic staff are actively participation Latvian and International associations/communities, as example prof. I.Jackiva in European Conference of Transport Research Institutes (ECTRI), prof. I.Kabaškins in Institute of Electrical and Electronics Engineers (IEEE), New York Academy of Science, International Telecommunication Academy, International Academy of Astronautics, OECD/ITF Transport Research Committee, prof. Boriss Mishnevs is a member of the INFORMATICS EUROPE etc.

Future plans for the development of international cooperation in scientific research:

- Publications of research and academic staff in internationally peer-reviewed publications
- Participation in international recognized scientific conferences
- Participation in the implementation of international projects, increasing the internationalization and international competitiveness of higher education and research
- Support measures for international mobility and cross-border cooperation. To conclude agreements for the implementation of international activities in the frame of the Erasmus+ programs
- Ensure scientific and professional development of academic staff and exchange of international experience within the EU support programs. Collection of good practice examples.
- Integration of digitalization and innovation learning tools and technics, providing high-quality and competitive educational service with higher added value
- To develop new directions for scientific and applied research and development of innovations, as well as for the development of new educational programs

- Strategic partnership with Latvian universities, research institutions, and the business sector
- Agreement on cooperation with industry and associations for the improvement of study programs, according to the needs of the labor market.
- Cooperation with employers, entrepreneurs, company managers, and industry specialists for the commercialization of research outputs
- Development of lifelong learning, according to labor market requirements and personal interests and needs - in cooperation with employers and industry associations.
- Increasing the involvement of students in the development of innovations, and support of promising projects transfer into startups and spinoffs
- Developing new thematic research Clusters within the main areas of research activities

The list of collaboration agreements with national and international research entities, organisations, business entities is provided in Annex 15.

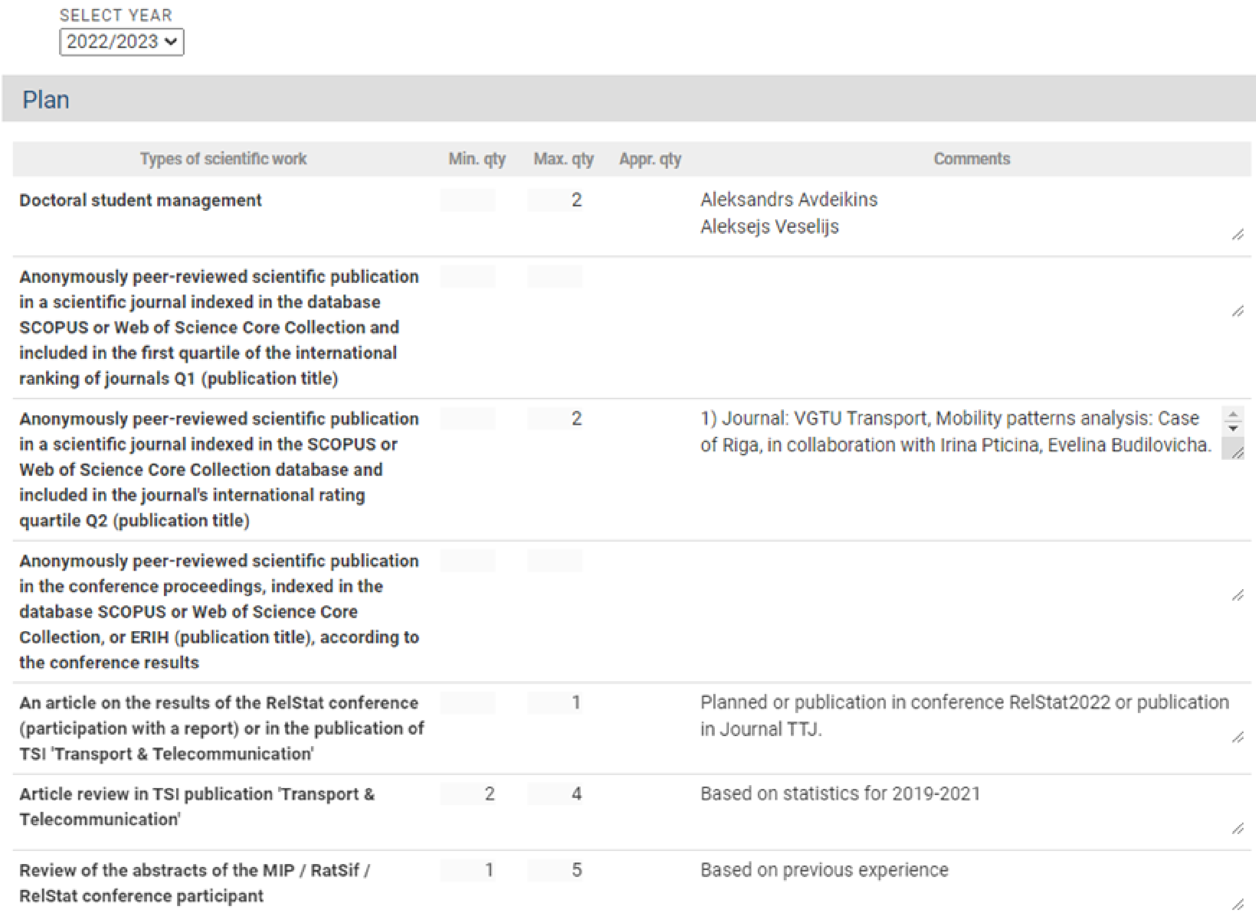
2.4.4. Specify the way how the higher education institution/ college promotes the involvement of the teaching staff in scientific research and/or artistic creation. Provide the description and assessment of the activities carried out by the academic staff in the field of scientific research and/or artistic creation relevant to the study field by providing examples.

The staff development strategy of TSI is based on the multifaceted development of the academic staff, which includes their involvement in the scientific research. The TSI Development Strategy 2020 - 2025 https://tsi.lv/wp-content/uploads/2020/07/TSI-Strategy-2020-2025.pdf defines 5 strategic objectives related to the research and scientific activity:

- to conduct high quality impactful applied research that will strengthen the reputation of TSI as a leading private technical university in the Baltic Sea region;
- to develop an internationally recognised research staff who are active in the innovations in the industry;
- to create a critical mass of employees involved in research and to establish a source of training for future researchers;
- to establish focused, multidisciplinary research clusters addressing the key societal issues that can have national or international impact;
- to promote the achievements of TSI worldwide.

The Institute of Transport and Telecommunications uses a variety of motivational schemes and policies to ensure and encourage the engagement in research and research activities.

1. Each faculty member shall include the research activities in his/ her individual work plan for the academic year. The submission and processing of information is organised on the TSI Lecturer portal https://teacherplan.tsi.lv/. The entered activities and the planned numerical results are discussed individually with each academic staff member by the Dean of the respective faculty. An example of the planning of academic and scientific activities for one faculty member is shown in Figure 9 below. These data are also used for budget planning.



SELECT YEAR

2022/2023

Plan

Types of scientific work	Min. qty	Max. qty	Appr. qty	Comments
Doctoral student management		2		Aleksandrs Avdeikins Aleksejs Veselijs
Anonymously peer-reviewed scientific publication in a scientific journal indexed in the database SCOPUS or Web of Science Core Collection and included in the first quartile of the international ranking of journals Q1 (publication title)				
Anonymously peer-reviewed scientific publication in a scientific journal indexed in the SCOPUS or Web of Science Core Collection database and included in the journal's international rating quartile Q2 (publication title)		2		1) Journal: VGTU Transport, Mobility patterns analysis: Case of Riga, in collaboration with Irina Pticina, Evelina Budilovicha.
Anonymously peer-reviewed scientific publication in the conference proceedings, indexed in the database SCOPUS or Web of Science Core Collection, or ERIH (publication title), according to the conference results				
An article on the results of the RelStat conference (participation with a report) or in the publication of TSI 'Transport & Telecommunication'		1		Planned or publication in conference RelStat2022 or publication in Journal TTJ.
Article review in TSI publication 'Transport & Telecommunication'	2	4		Based on statistics for 2019-2021
Review of the abstracts of the MIP / RatSif / RelStat conference participant	1	5		Based on previous experience

Fig. 9. A view from the faculty workload planning portal

1. In order to increase the number of scientific publications of lecturers in internationally cited databases, the remuneration policy of the academic staff of TSI provides for separate payment for high-level scientific publications, patents, participation in conferences, etc. These activities are paid once a year. The budget of the Institute of Transport and Telecommunications also foresees the additional costs for publicity activities; in order to obtain funding a request must be completed and submitted (https://tsi.lv/staff/document-forms/).
2. The scientific and teaching activities of the professors and associate professors are evaluated every two years. This performance evaluation also includes an evaluation of scientific and research activities. During the evaluation procedure, the Commission shall examine and discuss the current performance results, make recommendations and discuss the plans for the next 2 years. The procedure is available at ((https://tsi.lv/staff/document-forms/).
3. TSI participates in the implementation of the international projects involving TSI academic staff according to their scientific and professional interests. It provides an opportunity to acquire new knowledge and skills, to design and develop new innovative scientific ideas and to find promising applications for them, and also facilitates the transfer of knowledge and best practices from foreign partners (see Appendix 15).
4. The Department of Research Administration provides the support for the organisation of research and scientific activities of academic staff by informing them about the opportunities to participate in projects, the open calls for project applications, supporting the preparation of the project applications, and providing administrative management of the projects.
5. The research activity of the faculty is facilitated by the opportunity to participate in the conferences organised by TSI, which are available to the TSI academic staff at a significant discounted fee: the International Conference “Reliability and Statistics in Transportation and

Communication” and the International Scientific Practical and Teaching Methodological Conference “Modern Problems of Education”, as well as participation in the international scientific conferences and seminars organised by the University cooperation partners in Latvia and abroad.

6. The TSI scientific journal “*Transport and Telecommunication*”, indexed in more than 41 bibliographic databases (including SCOPUS), is a good opportunity for the academics staff to share the research results with the journal audience. Both the journal and the conferences provide an opportunity for TSI faculty and researchers to carry out the publicity activities, especially useful for the doctoral students and young researchers.
7. In order to ensure the scientific and research environment, the research infrastructure and the material and technical base for conducting the scientific research are developed. The Faculty of Engineering has established 2 research clusters with the main objective of bringing together the researchers and leading lecturers, they are Data Analytics and Artificial Intelligence research cluster and Modelling-Based Systems Analysis and Design (MADSYS).
8. Honorable mentions and awards at the annual birthday celebration of the Transport and Telecommunication Institute on the 6th of September should be noted as a form of non-material motivation. The list of awards includes the ones to the best young scientist, for the contribution to the development of innovative methods and technologies, the involvement of students in scientific work, the implementation of scientific results, for the high scientific productivity of the young scientist (publications), for the contribution to the development of an interdisciplinary approach, etc. For example, in 2022, Professor Aleksandrs Grakovskis was recognized for his intensive participation in the applied research.

The presented motivation scheme was implemented 1.5 years ago and now it is not possible to evaluate the impact of the implemented scheme and its effectiveness. But first results sure TSI management that presented a motivation scheme can promote academic staff involvement in scientific and applied research activities. After the scheme was established, the number of research publications in Q1-level journals grew. The research cluster organization assisted in successfully completing 3 research projects with industrial partners. SciVal system statistics also demonstrate, that number of involved staff grew, also the number of publications in collaboration with international researchers and research entities. Described motivation scheme is a primary tool for faculty management to plan resources and follow the task execution progress. In overall we believe that the motivation scheme is effective and serves to achieve TSI's goals, but at the same time, TSI's management plans to continuously monitor performance results and, if necessary, modify and continuously develop the motivation scheme, as the overall goal of the motivation scheme is to make a shift from quantity to quality in the domain of science and research.

Taking into account the directions of the research defined by TSI: ICT (Telematics), Smart Solutions in Transport and Logistics, Digital Society and Economy, it should be stated that the accredited study direction fully corresponds to the determined directions of the research activity. This is supported by the publication topics of the academic staff’s publications (see Appendix 14) and the overall profile of the publications. According to Elsievier data (scival.com), the majority of publications are in the fields of Engineering and Technology and/or Natural Sciences (see Figure 10).

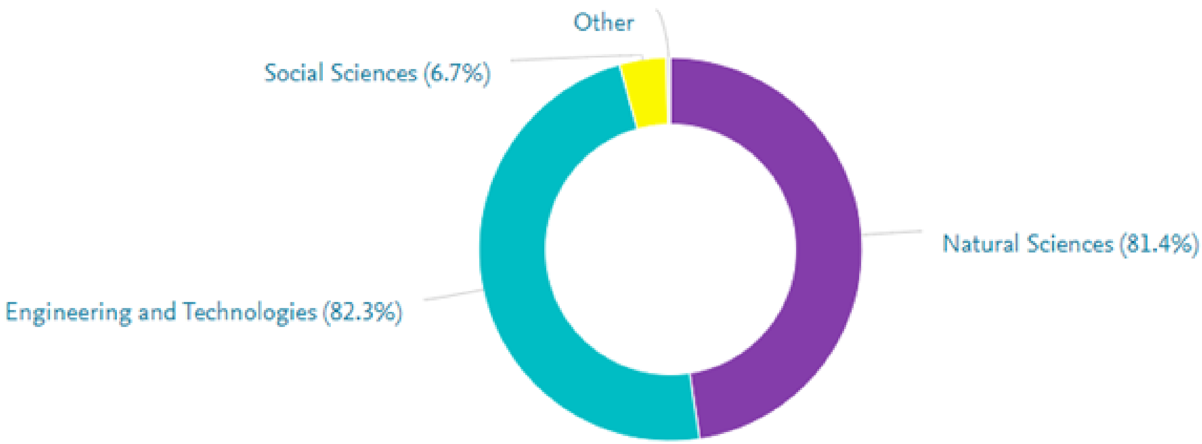


Fig.10. Distribution of publication by scientific directions

The relevance of the research carried out by the faculty members to the scientific field is also reflected in the nature of the projects implemented by TSI, most of which are related to the identified research areas. Applied research is exemplified by joint research with industry:

- Development of a Slot System for Multi-Complex IHC Histological Staining
- Research on the development of a 3d point cloud algorithm
- Development of the FARO Laser Scanner External Panoramic Camera
- Simulation of traffic flow around the “Acropole” shopping centre
- Development of demo of an innovative cash register system
- Development of a solar cell simulation model
- Impact of traffic flow on airport development scenarios, and others

The projects at the EU level are also linked to the specific research directions, such as:

- Ecosystem for European Education Mobility as a Service: Model with Portal Demo;
- INGENIOUS-strengthenINg diGital pEdagogy skills aNd competencIes Of edUcatorS
- Workforce Europe – Transformation agenda for transport automation (We-Transform)
- Fundamentals of Design Competence for Our Digital Future (D-Code)
- Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer (ePIcenter)
- Digitally supported and virtual study practices for modern logistic systems (DIGILOG)
- Enhancing excellence and innovation capacity in sustainable transport interchanges (ALLIANCE) and others.

Patents are a significant applied research result. During the reporting period 6 patents were applied and successfully registered, all of them are in the frame of the study direction: Method and device for control of wind-mill (LV15217 (A)), Device for registration of low-density magnetic fields (LV15134 (B)), Device for noise control of wind electric device (LV 15107 (B)), Method and device for transporting long wind turbine blades (LV15052 (A)), Device for registration of magnetic field in electric facilities (LV15042 (A)), Road vehicle weigh-in-motion method, system and apparatus (EP2878935 (A1)). In addition, by December 2022 the application for a patent “Automated staining apparatus with improved staining slot module” has been submitted for review (in collaboration with an industrial partner).

The above-mentioned activities and measures allow stating that 1) the Institute of Transport and Telecommunications in general and within the specific direction supports and promotes the scientific and research initiatives of the academic staff by using various tools and activities; 2) provides an enabling environment for scientific and research activities; 3) the carried out scientific and research activities, publications and projects are in line with the defined directions of the research activities, the academic and scientific profile of TSI and RIS3 specialisation of Latvia.

2.4.5. Specify how the involvement of the students in scientific research and/ or applied research and/or artistic creation activities is promoted. Provide the assessment and description of the involvement of the students of all-level study programmes in the relevant study field in scientific research and/ or applied research and/or artistic creation activities by giving examples of the opportunities offered to and used by the students.

Students' involvement in the research projects during the implementation of the study programme is ensured by the development of study papers and final exams included in the study courses. Students are involved in scientific research work in order to obtain new, useful knowledge, professional skills, competence and to create a connection between knowledge and practice. The topics of students' research works are topical, related to the economic sector.

Additional involvement of Bachelor level students in research in the direction of studies is provided by the following activities: involvement in the research and applied projects, events related to the development of innovations and knowledge transfer (Innovation & Knowledge Transfer), and involvement in scientific events: conferences, seminars, workshops.

Students' participation in TSI projects ensures the development of additional competencies and skills: application of acquired knowledge in practice, research work, analysis, experimental work skills. Student involvement takes place at all stages of the project - from the development of the idea and project application, to real project activities and the use of project results. The body responsible for disseminating information about opportunities to participate in scientific activities is the Research Administration Department, which prepares and transfers information about current and planned scientific activities to faculty employees, for informing students. Also, the information is transferred to the TTI student self-government for distribution in the students internal environment.

Special attention is paid to students' creation of new products / technologies, transfer of developed results to industry, strengthening of competencies in creation and implementation of new companies and business solutions. In 2021, the innovation and entrepreneurship center iDEAHUB was established at TTI, the purpose of which is to promote the implementation of student innovation applications, which develops students' innovation potential, skills and entrepreneurial abilities, solves important problems for society, strengthens cooperation between universities and students with entrepreneurs, merchants and industry.

Functioning ecosystem of the iDEAHub, perform projects with working prototypes:

- **DiPROGer**: development of a drone platform available and simple to use for all sectors of the national economy: from a small family farm up to critical infrastructure service providers. Core of idea – to use mobile device as a drone "all-in-one" electronic component (cameras, sensors, 5G, etc.). Project prototype includes algorithms, software, special control interfaces development. Research directions of the students' activities consist of data structures and algorithms, software engineering, programming.

- **iNNovatic**: developing prototype that automatically evaluates the compliance of the parameters of manufactured parts and structures with specifications and accuracy, based on a non-contact approach. Idea is to create manufacturing details acceptance control technology that would replace regular usage of hand-held measuring instruments, reduce human-factor in the acceptance process and automate manual work. Development includes integration of different scanning systems based on LIDAR technologies, CNC systems, image-recognition technologies, etc. Teams research area covesr directions of the object-oriented programming, systems modelling, software engineering, mobile and web application development.
- **Volkirion:** developing a prototype - a glove that will scan the environment and transfer information about objects to the hand using tactile input. Core idea is a stereo camera attached to the hand, the video from which will be converted into a depth map fed to the hand. The device will enrich the life experience of blind and visually impaired by expanding their sense via touch. Students works with sensors integration, algorithms development, system architecture and software development.

In 2021/2022 academic year in total 8 projects were developed with students' involvement (iDEAHub initiative and applied research projects. In total 30 students were involved in project activities. In the frame of the iDEAHub initiative research teams consisted only of students (except the mentor, who is TSI academic/research staff and who provides only consulting services to students. In the frame of the applied research projects in each project 2-3 students were involved, and the rest staff is TSI academic/research staff.

The active student's participation is carried out as part of the development of applied projects for the industry (R2B), where bachelors and masters' students are taking direct part in the project and developing software components and other computer systems for industrial prototypes such as:

- **TONES**: development of technological prototype of the Immunohistochemistry multiplex sample staining slots system, based on microfluidic technologies. Biomedicine domain industry will receive new system, with very user-friendly software, that increases R&D capacity in very important medical domain.
- **PhotoScan**; development of a system for a scanner (FARO S-series) that's able to take panoramic photos during (the same time) of LIDAR scanning process, reducing the scanning time and operational costs. Doctoral students are involved in large-scale scientific projects implemented by TSI in cooperation with international consortiums within EU program HORIZON2020:
- **Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer (ePIcenter). 2020- 2023:** will create an interoperable cloud-based ecosystem of user-friendly extensible Artificial Intelligence-based logistics software solutions and supporting methodologies that will enable all players in global trade and international authorities to co-operate with ports, logistics companies and shippers, and to react in an agile way to volatile political and market changes and to major climate shifts impacting traditional freight routes.

The project "Fundamentals of Design Competence for Our Digital Future" (DCODE 2021- 2024) will train a cohort of 15 PhD students in design, design anthropology, media studies, science and technology studies and data science, and equip them with the holistic understanding needed for the human-centric design of product service systems powered by Big Data, Machine Learning and Artificial Intelligence. DCODE brings together an exceptional team of internationally leading researchers in the required subject areas, and non-academic partners that bring societal, economic and political practice to the project and provide multiple forums for the dissemination of knowledge, results and best practices.

ALLIANCE project helped arrange Summer Schools for students and establish the international team of researchers in multidisciplinary area ICT application in transportation. The result of such teams are scientific publications.

Starting from 2002, TTI organizes the student scientific conference “Science and Technology - a Step into the Future”, RatSif, which provides an opportunity for young researchers to participate in an interdisciplinary scientific conference and cooperate with experienced scientists.

Conferences are held twice a year - in December and April. It is mandatory for students of all Master study programmes implemented by TTI to present the research at the conference before defending the work of the final examination. TTI undergraduate students and young scientists, doctoral students, graduate students and students from Latvian and foreign universities are also invited to participate in the conference.

A plenary session is also organized as part of the conference, during which participants have the opportunity to listen to interesting presentations by Latvian and foreign scientists: https://tsi.lv/the-annual-conference-ratsif-2021-was-held/

The abstracts from the conference are published in book of abstracts https://tsi.lv/research/publications/research-journals/research-and-technology-step-into-the-future-scientific-research-journal-on-line-editions/

Students, together with their supervisors, participate in the TTI international scientific conference “Reliability and Statistics in Transport and Telecommunication” (RelStat).

2.4.6. Provide a brief description and assessment of the forms of innovation (for instance, product, process, marketing, and organisational innovation) generally used in the higher education institution, especially in study field subject to the assessment, by giving the respective examples and assessing their impact on the study process.

In the frame of the current study direction the different kind of the innovations are highly utilized implementing academic, research, and administrative processes. There are a lot of examples, therefore in this section only several will be highlighted as a core one. In the study process administration, the use of the IT technologies is high, as example students are needed to validate their students cards (using validators in each class-room), the data about the attendance is recorded to the database and next, data about attendance are analyzed in weekly basis. With weak attendance students are receiving SMS messages, about low attendance level.

Also, as TSI utilizes LMS system (Moodle base) several learning analytics tools of the platform are utilized to follow student’s progress. The impact of the described solutions is targeted on improvement of the student’s study experience. Additionally, students are provided by the personal student’s workspace, which allows them to complete communication with TSI administration and follow their progress and data in the remote form. The primary impact of the solution is to create a digital environment for students, which will make their study process smooth, clear, and transparent. In the academic domain several examples could be mentioned. From methodological point of view several innovation could be mentioned, as example use of flipped-classes, learning by doing, provision of online classes in synchronous and none synchronous modes, intensive used of simulators, game-based learning, use of the online courses to cover the part of the course etc.

Also, should be noted that in 2022 TSI has been involved in two projects for the activity "Digitalisation initiatives to improve the quality of studies. Both projects have been accepted and it is expected to have even more innovative solutions in the academic domain. All the mentioned activities are targeted on providing innovative, project-based, modern environment for which will motivate them and develop digital and soft skills. As the core example the learning-by-doing activities could be mentioned. The students are involved in different level projects and labs to develop their professional, research and soft skills. An example is a PhotoScan project. This project was done in the interests of an industry representative. The purpose of the development was to create an innovative system for the FARO industrial laser scanner - a device that allows you to take panoramic color photographs and assign color values to a cloud of points obtained during scanning while the system had to do this simultaneously - during the scanning process. The project included the development of algorithms, image processing, software development, and hardware development. To implement the project the number of the students has been involved from different study programs.

Another example of innovation and its transfer to the educational process is the IdeaHub project. As part of the implementation, an innovative ecosystem has been created that combines the research infrastructure of TSI and external partners, research personnel, and experts. Competences for development and learning are combined in the form of innovative digital courses on the IdeaHub digital platform in the form of courses and training - both live and recorded, in areas such as Design, thinking innovations development and management, etc.

There are also different innovative approached utilized in the marketing of the study direction and programs, as one example is a humanoid robot NAO, which has been enriched by the specific presenter/teacher functionality (as part of the learning by doing project). And now the robot is highly utilized during different kind of the events (robot is able to conduct short multimedia presentations). As example last time it was during the EU level event – The night of science. The robot has provided several times the presentation about life in the digital city. Also the mentioned robot is used in activities with secondary schools to promote, not only TSI, but STEM in overall.

2.5. Cooperation and Internationalisation

2.5.1. Provide the assessment as to how the cooperation with different institutions from Latvia (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners for the study field and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the cooperation partners.

The aim of the study direction is closely related to the involvement of cooperation partners. Without cooperation partners there would be no sustainable development of the study direction, there would be no student training consistent with the requirements of the labor market.

The main criteria for initiating cooperation are the following: the reputation of the partner, compliance with the specifics of the industry, the common scientific and research interests of teaching staff and the benefits of all cooperation partners. The choice of cooperation partners of employers is determined by the demand of organizations for specialists in the relevant field. These are public and private organizations, various institutions and companies in Latvia and abroad. Appendix 15 Signed cooperation agreements

Employers are involved in study and research activities to ensure the use of their experience in the implementation of the programmes. The study programmes provide the following forms of cooperation with the employers and professional organizations:

1. Employers and their organizations are included in the Faculty Council and the Council of Study Fields, as well as in the accreditation working group of the study field. This ensures their involvement in the improvement of the study field and programmes, which allows maintaining a close connection with the current trends in the national economy. For example, employers are involved in the Council of the Faculty of Engineering and the Council of the Study Field, see Chapter 1.4. and Appendix 7.
2. The employers' representatives are included in the composition of the final examination commissions. Although the relevant regulations of the Cabinet of Ministers on the standard of academic education do not require mandatory involvement of the professional organisations of the sector or employers' representatives in the commissions, the final examination commissions of all study programmes include the employers as the chairpersons of the commissions. Anatoly Plotkin - Specialty Lead at Accenture, Vadims Stroiteļevs - Dr.sc.ing., LGS senior expert, Aleksandrs Berežnoj - Dr.sc.ing., Ltd "Tieto Latvia" represent the employers for the study programmes.
3. Conducting and reviewing the study and the final theses and offering topics for the final theses (formulating the problems to be solved in companies so that companies can develop the economically sound solutions).
4. Employers are involved in the guest lectures. This happens both by centrally inviting industry specialists to present the professional study courses, and as individual company guest lectures. For example, during the last academic year, there were the following guest lectures for the students of the field of the study:

20.09.2021.- Clarity, introductory lecture Welcome Week

21.09.2021. Accenture, introductory lecture Welcome Week

21.09.2021. Lursoft Latvija, Work at Lursoft.

22.09.2021. Swedbank, introductory lecture Welcome Week

28.09.2021. Lursoft Latvija, Work at Lursoft

27.10.2021. Accenture, Cloud Integration

10.11.2021. 1NCE, Behind the scenes of real IoT.

08.12.2021. S7 ENGINEERING, Information systems in the aviation industry and requirements for IT specialists.

08.12.2021. S7 ENGINEERING, Digitalization in the area of maintenance, repair, and continuous airworthiness of aircraft.

28.03.2022. Accenture, AI for QA (Testing)

01.04.2022. Accenture, Modern DevOps technologies, tools and architecture's solutions

09.04.2022. Clarity, Low-code and No-code development - today and in the future

5. There organised the special courses, fully provided by the guest lecturers invited from the industry. In this area, a very close cooperation has been established with the company Accenture Baltics, which, for example, annually provides a course on Java application development both in Latvian and English.
6. The specialists of the industry’s leading companies have been invited to teach several professional courses in the programme. This provides students not only with the practical knowledge acquisition necessary in the industry, but also promotes the cooperation opportunities of the university itself. In some cases, these specialists were elected to the TSI academic positions: J. Kijonoka, J. Revzina, S. Šarkovskis
7. Employers participate in the surveys for evaluating the skills acquired by the graduates of the programme and in the round table discussions. For example, a round table discussion of 23.05.2021, devoted to the improvement of the study programmes was attended by: Vitaly Vilims, Chief Executive Officer, SIA "Robologic", Aleksejs Lomovcevs, project manager, TECHNOMATIC SIA, Juris Ormanis, researcher, Institute of Electronics and Computer Sciences, Deniss Baribins, Radio Equipment Regulator , SAF Tehnika, Aleksandrs Berežnojs - Dr.sc.ing., Ltd “Tieto Latvia”, Security manager.
8. The representatives of the partner institutions, including industry, participate as experts in the iDEAHUB evaluation committee for students’ projects applications: Institute of Electronics and Computer Science, Latvian Information and Communication Technology Association (LIKTA), Mechanical Engineering and Metalworking Industry Association (MASOC), Investment and Development Agency of Latvia (LIAA) and others.
9. Provided scholarships for students: https://tsi.lv/future-students/loyalty-grants/
10. The connection with the employers is also strengthened through the active participation of the academic staff in the professional organizations and associations, the most important of which are LIKTA, LETERA, Latvian Aviation Association, ECTRI, Latvian Transport and Education Association, etc. The academic staff of the field of the study participate in the working groups organised by the ministries (for example, the expert working group of professional standards)
11. Cooperation with the employers, providing training for employees of the corporate clients in the programmes implemented by TSI with a tuition fee discount.
12. The academic staff of the higher education institution of the study field actively participate in the contract research (detailed information is provided in Chapter 4.3), as well as participate in the provision of the training courses (for raising qualifications).
13. TSI organises Career Days every year. During them, the presentations of employers’ organisations take place, and the guest lectures are delivered; the representatives of employers talk about career opportunities in the represented organisation and give practical advice on how to succeed in the labour market, as well as round table discussions.

There are various forms of cooperation with Latvian educational institutions, universities and scientific institutions: reviewing and advising the doctoral theses, joint participation of the academic staff and the doctoral students in research, conferences and seminars, joint scientific publications, etc. For example, the seminar “Robotics and coding” for teachers of the 80th secondary school in Riga, was organised for improving the digital competences of school teachers. The participants of the seminar got acquainted with the possibilities of programming the functionality of the NAO robot using the Python programming language, as well as with the use of artificial intelligence algorithms in human speech recognition.

In order to strengthen the digital capacity of Latvia’s leading universities, in the fall of 2022, the Institute of Transport and Telecommunications participated in 2 consortia for the implementation of projects in the field of digitization. The project "Automation tools for creative industries AutoRade" will be implemented in cooperation with 5 Latvian universities and 3 business partners - University of Economics and Culture (lead partner), University of Latvia, Rezekne Academy of Technologies, Vidzeme University of Technology, Liepaja University and Latvian Digital Accelerator, Ventspils High Technology Park and Valmiera Development Agency. The project “Digitalization initiatives for the involvement of students and the improvement of the quality of education at the University of Latvia and the universities - cooperation partners of the project” will be implemented in cooperation with 4 other Latvian universities - University of Latvia (leading partner), Latvian University of Agriculture, Vidzeme University, RISEBA University of Business, Arts and Technology, as well as three business partners – “Baltijas datu Akademiia” Ltd., “Tilde” Ltd. and “Computer Science Center” Ltd. The aim of both projects is to promote the use of digital technologies in the study process.

As part of the cooperation agreement with the University of Economics and Culture, students are offered free choice elective courses (block C).

Several TSI professors are also involved in the Councils of Professors of other universities, for example, professor I. Kabashkins is in the Council of Professors of the University of Information Systems Management, etc. In cooperation with the University of Business “Turība” and BA School of Business and Finance (BASBF), a joint Council of Professors in the field of Economics and Entrepreneurship has been established.

Lecturers and students of TSI and other universities cooperate in the scientific and academic conferences, seminars, and in the preparation of the scientific publications.

Cooperation with various Latvian universities, scientific institutions, employers, employers’ organisations, social partners, scientific institutions within the framework of the study direction provides an opportunity to ensure the goal set by the TSI study field and achieve the study results according to the goal of the study field.

2.5.2. Provide the assessment as to how the cooperation with different institutions from abroad (higher education institutions/ colleges, employers, employers’ organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study field contributes to the achievement of the aims and learning outcomes of the study field. Specify the criteria by which the cooperation partners suitable for the study field and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the cooperation partners.

Taking into account the integration of Latvia into the European Union, business globalisation and the international nature of information and communication technologies, study programmes are implemented in both Latvian and English. As a result, the students learn english ICT terminology better. TSI education strategy envisages becoming the leading private technical university in Latvia and in the Baltic Sea region, also implementing the study programmes that meet the interests of the international target audience, based on the current and future needs of the industry, which will be affected by the 4th industrial revolution, which will bring changes in the operation of companies, business organisation and the life of society. Therefore, the following goals of international involvement have been set:

- internationalization of studies, training and research;

- ensuring the effective attraction of foreign students, implementing marketing, recruitment and student attraction activities adapted to the specific countries;
- development of international partnerships and cooperation, creation of a strategic partnership with the University of Great Britain (UWE);
- expansion of the research cooperation networks;
- promotion of the mobility opportunities for the TSI students and staff;
- expanding staff opportunities and increasing the motivation to engage and actively participate in the internationalization process.

Within the field of the study, TSI participates in the work of several international organisations and the implementation of the international projects. Every year the cooperation is ensured with the increased number of foreign universities and scientific institutions, providing the opportunity for the students to study or do internships abroad, as well as the cooperation of the academic staff in the fields of research and academic work.

Cooperation with the foreign universities and scientific institutes takes place both at the level of guest lectures, at the level of scientific project applications and project implementation, doctoral student internships, experience exchange visits, participation in the organising Committees of the international conferences, Editorial Boards of scientific and academic publications: participation in the Promotion Councils, etc. (see more in Chapter 4.)

TSI has established a wide network of partner universities in Europe. TSI implements the mobility activity of the Erasmus+ programme between the countries participating in the programme. In total, the university has concluded more than 50 bilateral cooperation agreements with the higher education institutions in 19 countries, including 30 agreements in the field of implementation of the study programmes, which allow both students to study at the partner universities as part of the exchange programme, and the lecturers to go on exchange trips to the partner universities to deliver the lectures and to visit seminars on the latest achievements in science. The concluded Erasmus+ cooperation agreements with the universities that implement the study programmes similar to the field of study https://tsi.lv/study/erasmus/.

In 2020, a strategic partnership agreement was signed with the University of the West of England Bristol (UWE), which, among other things, provides for cooperation in research and increasing the competence of the academic staff and the creation of the double diploma programmes. From September 2020, the TSI Bachelor programme in Computer Science will be implemented in the form of a double diploma, allowing the graduates of the programme to obtain also the UWE Degree in Computer Science and Software Development, and in February 2022 the Master programme in Computer Science, with a specialisation in Data Analytics and Artificial Intelligence was added. The Master level study programme also accepts students who do not have a basic education in the field of ICT, but who have at least 1 year of experience in the ICT companies. In this case, an entrance exam and an interview with the director of the study programme must be taken. In accordance with the terms of the concluded strategic cooperation agreement and the Academic Study Regulations approved by UWE/TSI, which govern the study process of the double diploma study programme, TSI is responsible for the admission of students and their compliance with the admission requirements, which are synchronised between TSI and UWE Bristol.

In 2020, a cooperation agreement with the French University of Engineering was signed. Within the framework of the first stage of cooperation, 17 students of this university studied the courses of their interest for a whole semester in spring 2021/2022 in the Bachelor programme of Computer Science.

In 2022, a cooperation agreement with the Kaunas University of Technology was signed; one of the forms of cooperation is sharing the resources, which allows remote studies to attract the academic staff with the necessary competence.

In the academic year 2022/2023, it is planned to jointly implement the following study courses in English: “Theory of Reliability and Technical Diagnostics Essentials” and Control programs design for industrial robots” will be taught to the students of both universities by the faculty members of TSI, while the “Electronic Design Automation (EDA)”, “Power Electronic Devices”, “Control programs design for industrial robots” - by the faculty members of Kaunas University of Technology.

Several conditions are taken into account when concluding cooperation agreements with the foreign universities. The offer of the study courses for the TSI students in English in the relevant field /sub-field of the study in order to ensure a maximum process of recognition and equalisation of the study courses after exchange studies. The possibility of creating the double diploma programmes is analysed, the study plans are compared, and the possibilities of providing the necessary study courses in English in both universities are compared. Also, the university research directions and the development possibilities of the scientific research are analysed.

Cooperation at the level of Promotion Councils. In accordance with the promotion regulations, the independent opinions of foreign reviewers are provided in the review of the doctoral thesis. TSI actively cooperates with the academic staff of various European universities as potential reviewers. During the reporting period, the academic staff from the following universities were engaged as foreign reviewers: Eftihia Nathanail (University of Thessaly, Greece), Slavomir Augustyn (National Defence University, Poland), ILia B. Frenkel (Chair Sami Shamoon College of Engineering, Israel), Dr.-Ing. Richter Klaus (Institute of Logistics and Material Handling Systems (ILM) of the Otto-von-Guericke-University Magdeburg), Prof. Gunnar Prause (Tallinn Technical University, Estonia) Jonas Stankunas, Ramūnas Palšaitis, Andrius Jeržemskis (Vilnius Gediminas Technical University - VilniusTech, Lietuva), Chatys Rafal (Kielce of Technical University Department of Mechatronics and Machinery Design, Poland), Juraj Vaculík (University of Žilina, Slovakia), Jaroslaw Sugier (Wroclaw University of Technology, Poland), Sergei Molokov – Coventry University (UK), Vytautas Paulauskas (University of Klaipeda, Lithuania), etc. The list of reviewers is continuously replenished through cooperation in the scientific projects, development of scientific publications, participation in the international conferences, etc. A permanent member of the TSI Promotion Council is the professor of Vilnius Gediminas Technical University(VilniusTech) Dr. Olegas Prentkovskis.

2.5.3. Specify the system or mechanisms, which are used to attract the students and the teaching staff from abroad. Provide the assessment of the incoming and outgoing mobility of the teaching staff in the reporting period, the mobility dynamics, and the issues which the higher education institution/ college faces with regard to the mobility of the teaching staff.

System for attracting foreign students and number of foreign students

According to the TSI Development Strategy, one of the main components of which is the internationalization of the Institute, TSI focuses on wider attraction of quality students, development of international partnership, etc., and purposefully implements the policy of attracting foreign students in the following way:

1. A new strategic partner has been selected to attract applicants from India, Jordan, Vietnam and Turkey - the international company *MSM* (M Square Business Solutions Inc.), which ensures the high quality selection of applicants, their examination and at the same time

advising applicants on the study opportunities and conditions at TSI.

2. TSI uses the services of agents to attract applicants from different countries. TSI has terminated cooperation with a number of recruitment agencies whose recruited applicants had a high dropout rate after admission to the university or did not meet all requirements from TSI. Each year TSI reviews the list of active agents and conducts the quality audit of the One of the objectives for 2022 is the expansion of cooperation in European and CIS countries, contracts are concluded with new agencies in Bulgaria, Greece, Romania, Georgia, Kazakhstan and Uzbekistan.
3. Participation in the international education exhibitions: for example, in 2021 TSI participated in online exhibitions in Kazakhstan, Uzbekistan, Georgia, Ukraine. The year 2022 started with face-to-face exhibitions in Kazakhstan, Uzbekistan, Georgia and Lithuania; there also planned participation in the exhibition in Serbia, which is a new region for TSI.
4. Seminars for potential students in cooperation with agencies. Such seminars are organized both when visiting foreign countries and online, using modern technologies and various platforms(Zoom, GoToMeeting, BigBlueButtom utt.).
5. Digital advertising campaigns on social networks (Facebook/Meta, Instagram) and the Google platform. Digital advertising campaigns are implemented by evaluating the popularity of social networks in each country, the available budget and the current offers at that time and the current economic and political situation in the world. In February 2022, an advertising campaign was launched to Lithuania also about distance learning study opportunities and TSI's offer for the Lithuanian market.
6. PR activities in foreign markets. When visiting foreign countries, the opportunity to publish information is used, mostly on social networks (Facebook, Instagram, LinkedIn) and on the TSI website about the visit, seminars, general information about studies in Latvia and at TSI.

TSI pays great attention to the selection and admission of foreign students. Various measures have been taken to attract the most promising students to the Institute and to address the risks associated with illegal immigration. The procedure for admission of applicants has been revised and improved by implementing the criteria for qualitative selection of foreign students for admission to TSI. With the year 2022, the admission requirements for applicants from India have been strengthened. Currently, students from India are not admitted with an average grade of the previous education certificate lower than 65%, and grades in Mathematics and English lower than 60%. An application has also been submitted for participation in the Agreement on Good Practice in Attracting Foreign Students, the new version of which will be prepared in 2022, and the signing process with universities will be carried out by the State Education Development Agency.

Foreign applicants who wish to study in the undergraduate programmes are required to take tests in accordance with the additional admission requirements of the study programme - a test in Physics and/or Mathematics and English.

The total number and share of foreigners studying in the programs of the study direction is given in Figure 11.

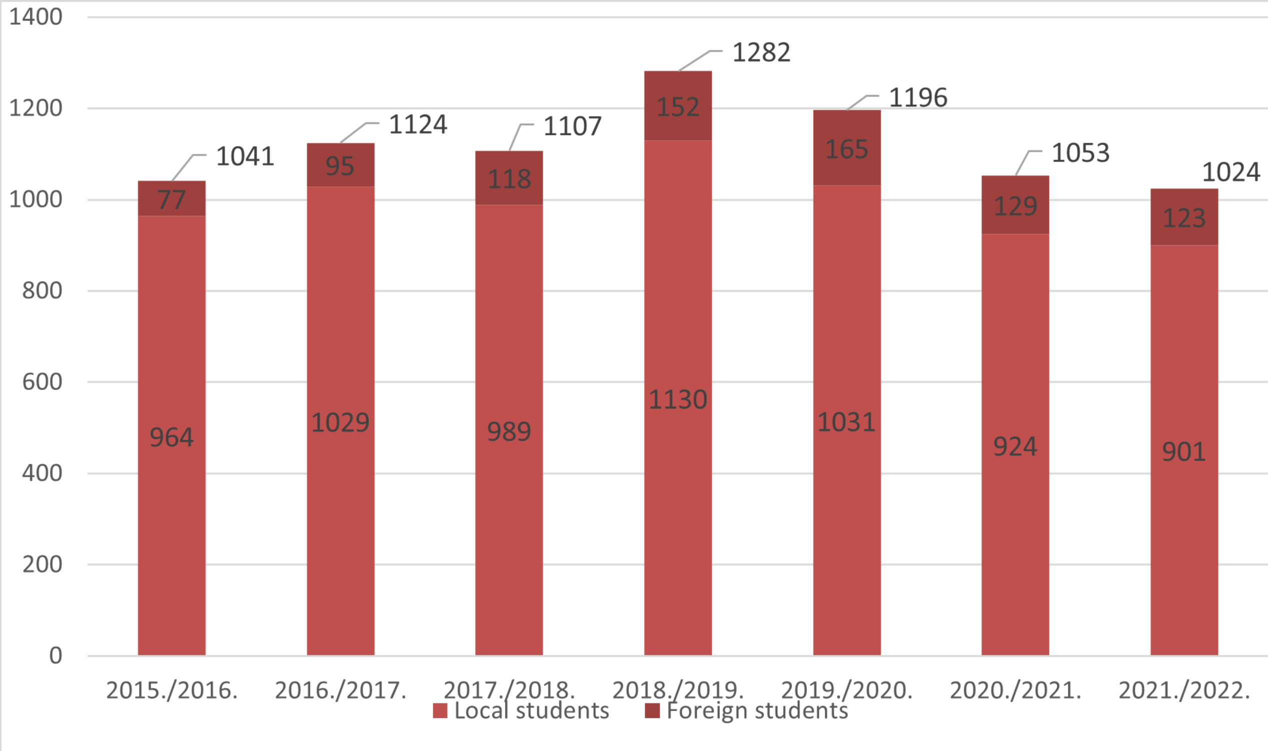


Fig.11. The number of foreign students in the study programmes

The number of foreign students in the field of the study increased from 7% in 2015/2016 to 14% in 2019/2020 (pre-Covid period), and currently for the second year it is 12% of all students in the field of the study. There are a total of 351 international students at the university, which represents 17% of all university students.

Foreign students at TSI have so far been able to study in English and Russian, and many foreigners, mostly from former post-Soviet countries, have taken the opportunity to study in Russian. Due to the amendments to the Law on Higher Education, which prohibits universities from admitting students to study in Russian, the last admission for studies with Russian as a language of instruction was in 2019. In terms of studies, the last Russian students will graduate in June 2023.

During the reporting period, there were 25 incoming and 26 outgoing students and 16 foreign lecturers in the ERASMUS+ mobility programme. Incoming mobility students are enrolled in one of the study programmes of the Faculty of Engineering in the status of exchange students, although in some cases exchange students choose to take the certain individual study courses from the programmes of other faculties as well. The recognition of the study results obtained during the ERASMUS+ programme is regulated by the TSI ERASMUS+ programme scholarship competition instructions (available at https://tsi.lv/wp-content/uploads/2023/01/tsi_erasmus_instrukcija-2023-eng-final.pdf).

The number of students who choose to go on exchange mobility from the programmes of the Faculty of Engineering is roughly similar to the number of incoming students. It should be noted that both incoming and outgoing mobility is based on the Bachelor level programme "Computer Science". TSI's mobility option is mostly chosen by students of social sciences programmes. The main reason for this is that students of engineering programmes usually start working during their studies, since the specialties are in high demand in the labour market. In the next reporting period, the faculty is planning to strengthen incoming and outgoing mobility, if necessary - even remotely online.

System for attracting foreign teaching staff

For internationalization of activities and increase of competitiveness on the national and international scale, as well as for the enhancement of study quality, TSI attracts foreign teaching staff using own resources and the financial resources of European Structural Funds. Foreign lecturers are invited to give guest lectures or teach study courses in accord with the Erasmus+ cooperation agreements and individual inter-university cooperation agreements. TSI announces recruitment on the European Commission's portal *Euraxess* and uses other types of attracting foreign lecturers, which tend to be various. Foreign lecturers are usually invited teach specialized and highly professional courses of the program, therefore, while selecting lecturers, the Faculty management gets acquainted with the latest publications in the specific field and establishes cooperation with the authors of specific research.

The human resources policy, including the engagement of foreign lecturers in teaching activities at the Faculty, is implemented in accordance with the development plan of the Engineering Faculty, which envisages a continuous increase in the number of foreign lecturers, considering that the programmes are also taught in English.

Foreign lecturers have been invited to teach in the program within the framework of the European Social Fund project *Strengthening the Academic Staff of the Transport and Telecommunication Institute in the Areas of Strategic Specialization* (No. 8.2.2.0/18/A/011), as example: Dr. Neil Rubenss (Japan), Dr. Ioseb Gabelaia (USA), Dr. Enrique Onieva (Spain), Dr. Shahid Mumtaz (Portugale), Dr. Eftihia Nathanail (Greece), Dr. Stefan Hermann Kuhn (Germany), Dr. Shahaboddin Shamshirband (Norway), Dr.Yasser Moustafa Kamal Abdelmonem Omar Youssef (Egypt), Ashish Seth (Uzbekistan) etc. A part of the mentioned teaching staff continues collaboration with TSI.

2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures

2.6.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by the experts during the previous accreditation of the study field, as well as the assessment of the impact of the given recommendations on the study quality or the improvement of the study process within the study field and the relevant study programmes.

The field of the study “Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science” was accredited by the decision No.172 of the Accreditation Commission of the Ministry of Education of of June 14, 2013.

The recommendations made in the previous evaluation procedures of the field of the study have been fully implemented, an analysis of the recommendations has been carried out and they are suitable for the specifics of the field of the study and the corresponding study programmes.

The impact of the recommendations received in the previous evaluation procedures on the quality of studies and the improvement of processes is positive. Implementing the recommendations made during accreditation the following activities were carried out:

Support for attracting foreign guest lecturers

Each year , the faculties plan a special budget (on average EUR 10 000) for attracting guest lecturers. In 2019-2020, within the project "Strengthening the academic staff of the Institute of

Transport and Telecommunications in the areas of strategic specialization" No. 8.2.2.0/18/A/011, 9 foreign guest lecturers were recruited to teach the study courses in the programmes. Cooperation with most of them continues even now, for example, visiting professor Shahid Mumtaz from Portugal (University of Aveiro), visiting lecturer Stefan Hermann Kuhn from Great Britain, and others. Also in 2015, during the implementation of the project "Development of the Institutional Capacity of the Institute of Transport and Telecommunications", several agreements were concluded on cooperation with both Latvian and foreign universities and research organizations, which, among other things, also provide for the attraction of guest lecturers, for instance, Institute of Electronics and Computer Science, University of Deusto and others. Currently, the Big Data course is taught in the Master level programmes by the visiting professor Neil Rubens, who is a leading data scientist at VISA Corporation, while in the double degree programmes, the introductory lectures in Computer Science in each study course are provided by the visiting lecturers from the UWE Bristol. Although the experts' recommendation has been fulfilled, the process of attracting the foreign teaching staff is continuous and ongoing.

Raising admission criteria and reducing the number of early school leavers

Experts had pointed to the need to strengthen admission requirements to reduce student drop-out. Factors that affect the students' desire to continue their studies are related to the severe shortage of labor in the field of both IT and electronics. As the TTI experience shows, by the end of the second year, most of the students already start to work, and therefore earn, and they often lose motivation to continue their studies, or it becomes difficult to combine studies with work. We try to solve this problem by using flexible and student-adapted lesson planning, for example, classes are concentrated 2-3 days a week. Another important issue affecting studies is the level of preparation in Mathematics and Physics. The problem is huge and needs to be addressed at the national level, but on the part of TTI, all first-year students are tested in Mathematics and Physics, and students who do not perform well in the tests are provided with extra classes in Mathematics and Physics. In 2022, TTI rewrote the contract with COURSERA, which allows recommending to students to complete sos courses to increase their knowledge (e.g. Mathematics for Engineers (contains 5 courses), Physics 101 - Forces and Kinematics, Physics 101 - Energy and Momentum, etc.). Special attention is paid to the admission of foreign applicants. In 2018-2019, the opinion of the Council of Higher Education was received, which allows the foreign applicants to take the entrance exams: in English, Mathematics and Physics. Also, special attention is paid to applicants from India, the average grade of their previous education certificate must not be lower than 65%, and the grades in Mathematics and English must not be lower than 60%. Therefore, it can be claimed that the recommendation for increasing the admission criteria has been fulfilled.

Support for students' scientific activities, including preparation of publications

The project "Innovation Grants for Students at the Institute of Transport and Communications" / iDEAHUB (Nr.1.1.1.3/21/A/006), implemented by TTI, plans 20 innovation projects. By September 2022, 8 projects are being implemented with a total number of students involved of more than 30 persons. 3 post-doctoral projects have been implemented in the last 5 years. The students' scientific conference "Science and technology - a step into the future" is held regularly twice a year, see more in the description of criterion 4.5. Two research clusters have been opened which, among other things, involve students in research: 1) Data Analysis and Artificial Intelligence Research Cluster; 2) Systems Analysis and Modelling Research Cluster. Therefore, it can be stated that involvement of students in the scientific activity is encouraged and the recommendation has been fulfilled

Promote the opportunity to learn study courses or practical experience at TTI partner universities, companies

Within the study field, companies award grants for studies in the following programmes: RoboLogic, Birkle IT, X-InfoTech, Clarity and others. The grants also provide the students with the opportunity to do internships at these companies. The cooperation with Accenture Baltics every year provides an opportunity for students to attend the practical classes and to gain professional knowledge in a specific field, for instance, JAVA, DevOps, Cloud technology bookcamps. In 2022 in autumn, an agreement on cooperation with Coursera was signed, which provides students with the opportunity to learn any Coursera course for free, including so-called professional courses (from Google, IBM, Amazon and others). In 2022, TTI started to implement a resource exchange project with Kaunas University of Technology (KTK), Lithuania, which will enable TTI students to obtain credit points at KTK by learning remotely the study courses at the cooperating university. The students participate in the ERASMUS + mobility programme. Two double degree programmes in Computer Science have been created, allowing the students to use simultaneously the learning resources of TTI and the UWE Bristole. Therefore, it can be claimed that the recommendation has been fulfilled. fulfilled.

Cooperation with the Alumni Association

The TTI Alumni Association (https://tsi.lv/tsi-alumni/association/), founded on January 30, 2016, promotes the connection between the institute and its alumni by providing a favorable environment for the exchange of experience and business contacts, offering the opportunities for qualification improvement, popularizing and supporting TTI, thus supporting educational processes at the university. Regular meetings with the best graduates are organized for the students.The LinkedIn profile of TTI is actively developing, which brings together more than 2 000 graduates, allowing effective monitoring of their future career paths, and promoting the mutual communication among the graduates themselves.

The existence of several identical programmes in the field of electronics

In the previous accreditation of the field, the experts pointed out that since the number of students is small, it is not appropriate to implement 2 similar electronics programmes. Taking into account the expert's recommendations, the number of students, the development trend of the markets, a decision was made to close the second level professional study programmes "Electronics" and "Telecommunication Systems and Computer Networks", leaving only one programme at the undergraduate level in the field of study, which would include the specifics of the programmes to be closed: Embedded Electronics Systems, Industrial Electronics, Telecommunication Systems and Computer Networks. Currently, one programme " Computer Engineering and Electronics " (formerly called Bachelor of Engineering in Electronics) has been submitted for accreditation, with three specialisations to compensate for the programs to be closed - thus, the recommendation on reducing the number of duplicated programmes has been implemented.

Improvement of facilities of laboratories

Taking into account the expert's comments, TTI has continuously upgraded the laboratories, and already in 2013 TTI opened the Telecommunications, Electronics and Robotics Center (TERC) in the framework of the ERDF infrastructure project " Information and Communication Technologies as a Common Academic Resource at the Transport and Telecommunications Institute (IKAR) ". In addition, in years 2017 - 2020 within the framework of another ERDF project, 2 new laboratories were created and 1 existing laboratory was modernized. There are 11 laboratories under the authority of TERC, for more details see Annex 9 of the study field. Also, in 2023, it is planned to create two more laboratories related to 3D printing and automated welding, so it can be said that the experts' recommendation has been fulfilled.

Increasing the number of publications

To encourage publicity activities, TTI reworked the remuneration policy, providing additional payment for publications and patents. This allowed for a significant increase in the number of publications in recent years, among them in Q1 journals. On average, 15 000 EUR is planned for these purposes in the budget. In order to increase the capacity of the TTI researchers, 3 postdoctoral projects have been implemented at TTI. 2 research clusters have been opened and another one is planned to be opened in 2023. The cluster serves as a tool to foster both research work and cooperation with industry. The members of the cluster from experienced researchers to Phd students and Master level students. In 2021, TTI launched the IDEAHUB project. The purpose of this project is not only to involve students in projects, but it is also an opportunity to nurture the new generation of researchers who are able to implement projects and publish. With the increase in the number of publications in recent years, it can be argued that the experts' recommendation has been fulfilled.

Feedback from industry companies

When implementing the recommendations, TSI conducts a continuous survey of graduates and employers (at least once every two years). For more details see the description of criterion 3.3. Several events are organized every year, or even several times a year, such as R2B calls, round table discussions, seminars, meetings between students and alumni who have often become employers themselves, and others. The primary goal of these events is to foster cooperation and dialogue between TSI and companies from the industry. Employers are included in the Council of the Study Field and the Faculty Council, which allows timely feedback from industry representatives.

Proportion of two-credit courses

Even though the recommendation to reduce the number of 2 credit point courses was not included in the experts' recommendations for this field of study (unlike other TSI study fields), such a recommendation was made during the oral evaluation of the Bachelor programme in Computer Science. Since the last accreditation, several course modules and extensive courses have been introduced. Thus, the recommendation to reduce the proportion of 2 credit point courses has been implemented.

2.6.2. Implementation of the recommendations given by the experts during the evaluation of the changes to the study programmes in the respective study field or licensed study programmes over the reporting period or recommendations received during the procedure for the inclusion of the study programme on the accreditation form of the study field (if applicable).

During the reporting period, one study programme was licensed in the field of study - the Bachelor programme “Robotics”. The licence No. 04038-24 of the study programme “Robotics” was issued on November 21, 2018 by the decision of the Study Programme Licensing Commission No. 83-L.

In the course of the licensing process, the experts made a number of recommendations, which had to be implemented after the issuance of the licence. The recommendations of the experts were taken into account and the attached Appendix shows the implementation plan of the recommendations received in the process of licensing.

Execution of the implementation plan of the recommendations provided by the experts is presented in Appendix 20.

Annexes

I - Information on the Higher Education Institution/ College		
Information on the implementation of the study field in the branches of the higher education institution/ college (if applicable)		
List of the governing regulatory enactments and regulations of the higher education institution/ college	Annex 2. TSI internal regulation list .docx	2.pielikums. TSI Iekšējo normatīvo dokumentu saraksts 3001.docx
The management structure of the higher education institution/ college	Annex 3. Management structure.doc	3.pielikums. TSI Struktūra 3001.doc
II - Description of the Study Field - 2.1. Management of the Study Field		
Plan for the development of the study field (if applicable)	Annex.4. Plan for the development of the study field.pdf	4.pielikums. Studiju virziena attistības plāns.docx
The management structure of the study field	5.pielikums. STUDY DIRECTION MANAGEMENT SHEME.pdf	5.pielikums. Studiju virziena parvaldibas struktursHema.pdf
A document certifying that the higher education institution or college will provide students with opportunities to continue their education in another study programme or another higher education institution/ college (agreement with another accredited higher education institution or college) if the implementation of the study programme is terminated.	Annex 23. Agreement between TSI and RTU.pdf	23.pielikums.TSI RTU vienosanas.edoc
A document certifying that the higher education institution or college guarantees compensation for losses to students if the study programme is not accredited or the study programme license is revoked due to actions (actions or omissions) of the higher education institution or college and the student does not wish to continue studies in another study programme.	24.pielikums. Apliecinājums par zaudejumu kompensaciju eng.pdf	24.pielikums. Apliecinājums par zaudejumu kompensaciju.pdf
Standard sample of study agreement	Annex 25. Sample of the study agreement.pdf	25.pielikums. Studiju l īguma paraugs.pdf
II - Description of the Study Field - 2.2. Efficiency of the Internal Quality Assurance System		
Analysis of the results of surveys of students, graduates and employers	Annex 7. Student, graduate and employer survey data.zip	7.pielikums. Aptaujas.zip
II - Description of the Study Field - 2.3. Resources and Provision of the Study Field		
Basic information on the teaching staff involved in the implementation of the study field	Annex 11. Academic staff involved in the implementation of the study direction.xlsx	11 pielikums Mācibspeku saraksts 3001.xlsx
Biographies of the teaching staff members (Curriculum Vitae in Europass format)	Annex 10. Biographies of the teaching staff members.zip	10.pielikums. Mācībspēku biogrāfijas.zip
A statement signed by the rector, director, head of the study programme or field that the knowledge of the state language of the teaching staff involved in the implementation of the study programmes within the study field complies with the regulations on the state language knowledge and state language proficiency test for professional and official duties.	Annex 21. Confirmation of knowledge of the state language.docx	21.pielikums. Apliecinajums valats valodas prasme 3001.edoc
A statement of the higher education institution/ college on the respective foreign language skills of the teaching staff involved in the implementation of the study programme at least at B2 level according to the European Language Proficiency Assessment levels (level distribution is available on the website www.europass.lv, if the study programme or part thereof is implemented)	Annex 22 Confirmation of foreign language skills at least at B2 level.docx	22.pielikums. Apliecinajums anglu valodas prasme 3001.edoc
II - Description of the Study Field - 2.4. Scientific Research and Artistic Creation		
Summary of quantitative data on scientific and/ or applied research and / or artistic creation activities corresponding to the study field in the reporting period.	Annex 12. Summary of quantitative data.docx	12.pielikums. Kvantitatīvo datu apkopojums 30012023.docx
List of the publications, patents, and artistic creations of the teaching staff over the reporting period.	Annex 13. Projects. Annex 14. Publications.zip	13.piel. Projekti_ 14.piel.Publikācijas.zip
II - Description of the Study Field - 2.5. Cooperation and Internationalisation		
List of cooperation agreements, including the agreements for providing internship	Annex 15. Cooperation Agreements.docx	15.pielikums. Sadarbība sligumi.pdf
Statistical data on the teaching staff and the students from abroad	Annex 16. Statistical data on the teaching staff and the students from abroad.docx	16.pielikums. Statistikas dati par ārvalstu studējošajiem un mācībspēkiem.pdf
Statistical data on the incoming and outgoing mobility of students (by specifying the study programmes)	Annex 17. Statistical data on the incoming and outgoing mobility of students.docx	17.pielikums. Statistikas dati par studējošo izejošo un ienākošo mobilitāti.pdf
Statistical data on the incoming and outgoing mobility of the teaching staff	Annex 18. Statistics on Teaching Staff Mobility.pdf	18.pielikums. Statistikas dati par macibspeku mobilitati.docx
II - Description of the Study Field - 2.6. Implementation of the Recommendations Received During the Previous Assessment Procedures		
Report on the implementation of the recommendations received both in the previous accreditation and in the licensing and/ or change assessment procedures and/ or the procedures for the inclusion of the study programme on the accreditation form of the study field.	Annex 19.Execution of the implementation plan of expert recommendations.docx	19..pielikums. Ekspertu sniegto rekomendāciju ieviešanas plāna izpilde 3001.docx
An application for the evaluation of the study field signed with a secure electronic signature	Application for the assessment of the study direction.doc	Iesniegums TSI IT virziena novertesanai 3001.edoc
III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme		
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)		
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period		
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard		
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme		
The curriculum of the study programme (for each type and form of the implementation of the study programme)		
Descriptions of the study courses/ modules		
Description of the organisation of the internship of the students (if applicable)		

III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)		

Other annexes

Name of document	Document
Studiju virziena padomes sastāvs	6.pielikums.SVP sastavs.pdf
Council of the study direction	6.pielikums. COUNCIL OF THE STUDY DIRECTION .pdf
Statement on the decision on the reviewed study program at the Senate meeting	1.pielikums. Senata izraksts eng.pdf
Pielikumu saraksts	Pielikumu saraksts.pdf
APPENDICES.pdf	APPENDICES.pdf
8.pielikums. Macību auditorijas	8.pielikums. Macību auditorijas.pdf
9.pielikums. Laboratorijas	9.pielikums. Laboratorijas.docx
8. Provision of TSI with classrooms	8.pielikums. Macību auditorijas eng.pdf
9.Provision of TTI with laboratories	9.pielikums. Laboratorijas eng 1710.docx
1.pielikums. Senata izraksts	1.pielikums. Senata izraksts.pdf
Annex 26. Previous accreditation expert recommendations for the study direction	Annex 26. Previous accreditation expert recommendations for the study direction.pdf
20.pielikums.Studiju programmas “Robotika” ekspertu sniegto rekomendāciju izpildee pārskats	20.pielikums.Studiju programmas “Robotika” ekspertu sniegto rekomendāciju izpilde.docx
Annex 20. Implementing the recommendations made by the experts of the “Robotics” study programme	Annex 20. Implementing the recommendations made by the experts of the “Robotics” study programme .docx
TSI skaidrojumi uz AIKA komentāiem	Skaidrojumi uz AIKA komentariem 3001.pdf
Explanation for AIKA's comments.pdf	Explanation for AIKA's comments.pdf

Computer Science (45483)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Computer Science*
Education classification code	*45483*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Dmitrijs*
Surname of the study programme director	*Pavļuks*
E-mail of the study programme director	*Pavljuks.D@tsi.lv*
Title of the study programme director	*Dr.sc.ing., Dr.oec.*
Phone of the study programme director	*29958338*
Goal of the study programme	*The programme aims to prepare computer science specialists at a high international level, who can independently learn and apply emerging technologies and best practices of software engineering and data analytics, critically analyse them, design and implement new solutions based on the latest advances in computer science, and also to apply soft skills to work in scientific and professional interdisciplinary projects and to realize themselves on the labour market.*
Tasks of the study programme	*• provide in-depth theoretical and practical knowledge in computer science,* *• develop the ability to critically evaluate existing methods, technologies, approaches, and tools and select the most suitable ones, considering technical, context, and ethical aspects,* *• motivate to continuous improvement of knowledge and skills within the specialization area,* *• develop research skills for further academic and scientific career development.*
Results of the study programme	*• Able to obtain and rationally examine the information and make reasoned decisions* *• Able to organise and lead teamwork, take responsibility for team performance, demonstrate leadership skills and results-oriented thinking* *• Able to conduct research in the IT domain, analyse data, state hypotheses, and make well-grounded conclusions and generalizations* *• Able to explore and utilise current and emerging technologies for lifelong learning and professional development* *• Able to design modern software solutions integrating ethical, social, legal, and economic responsibilities* *• Able to design, implement and maintain complex data stores and apply modern data organisation, representation and processing techniques* *• Able to design, develop, maintain, test and evaluate novel software solutions based on modern algorithms and data sources* *• Able to design, develop, maintain, test and evaluate novel data analytics, machine learning, and artificial intelligence solutions and apply them for solving real-world problems*

Final examination upon the completion of the study programme	*Master's Thesis*

Study programme forms

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences in Computer Science, Informatics, or Mathematics, or Bachelor’s degree in Engineering sciences in Electrical Engineering, Electronics, Information and Communication Technologies with number of completed credit points – 120 CP; or second-level professional higher education in corresponding field. - Second-level professional higher education or Bachelor’s degree in Economics, Management, Logistics, Finance, Business, or other fields – with at least 1 year of professional experience in the field of ICT, an interview with the study program director and an entrance exam in Speciality*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*

Admission requirements (in English)	*Bachelor’s degree in Natural Sciences in Computer Science, Informatics, or Mathematics, or Bachelor’s degree in Engineering sciences in Electrical Engineering, Electronics, Information and Communication Technologies with number of completed credit points – 120 CP; or second-level professional higher education in corresponding field. Second-level professional higher education or Bachelor’s degree in Economics, Management, Logistics, Finance, Business, or other fields – with at least 1 year of professional experience in the field of ICT, an interview with the study program director and an entrance exam in Speciality For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences in Computer Science, Informatics, or Mathematics, or Bachelor’s degree in Engineering sciences in Electrical Engineering, Electronics, Information and Communication Technologies with number of completed credit points – 120 CP; or second-level professional higher education in corresponding field. - Second-level professional higher education or Bachelor’s degree in Economics, Management, Logistics, Finance, Business, or other fields – with at least 1 year of professional experience in the field of ICT, an interview with the study program director and an entrance exam in Speciality*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences in Computer Science, Informatics, or Mathematics, or Bachelor’s degree in Engineering sciences in Electrical Engineering, Electronics, Information and Communication Technologies with number of completed credit points – 120 CP; or second-level professional higher education in corresponding field. Second-level professional higher education or Bachelor’s degree in Economics, Management, Logistics, Finance, Business, or other fields – with at least 1 year of professional experience in the field of ICT, an interview with the study program director and an entrance exam in Speciality For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences or Engineering or second-level professional higher education in Computer Science, Informatics, Mathematics, Electrical Engineering, Electronics, Information and Communication Technologies; number of completed credit points – 160 CP, and if the following mandatory study courses are completed: Programming (at least 6 CP) and Database Technologies (at least 4 CP)*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - english

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences or Engineering or second-level professional higher education in Computer Science, Informatics, Mathematics, Electrical Engineering, Electronics, Information and Communication Technologies; number of completed credit points – 160 CP, and if the following mandatory study courses are completed: Programming (at least 6 CP) and Database Technologies (at least 4 CP) For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*60*

Admission requirements (in English)	*Bachelor’s degree in Natural Sciences or Engineering or second-level professional higher education in Computer Science, Informatics, Mathematics, Electrical Engineering, Electronics, Information and Communication Technologies; number of completed credit points – 160 CP, and if the following mandatory study courses are completed: Programming (at least 6 CP) and Database Technologies (at least 4 CP)*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*Bachelor’s degree in Natural Sciences or Engineering or second-level professional higher education in Computer Science, Informatics, Mathematics, Electrical Engineering, Electronics, Information and Communication Technologies; number of completed credit points – 160 CP, and if the following mandatory study courses are completed: Programming (at least 6 CP) and Database Technologies (at least 4 CP) For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Nature Sciences in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

No.	Parameter	Changes made in the period since the previous accreditation	Changes made in the process of accreditation
1.	Field of Study	-	-
2.	Name of the study programme	According to the decision of the Study Quality Commission No. 2022/02-I of 19.01.2022. changed to “Computer Science” (previously “Master of Science in Computer Science”)	-

3.	The code of the study programme in accordance with the Latvian Classification of Education	According to the decision of the Study Quality Commission No. 2022/02-I of 19.01.2022. changed to 45483, based on paragraph 5.2 of the Cabinet of Ministers Regulation No. 322 “Regulations on the Latvian Classification of Education”.	-
4.	Type and level of the study programme .	-	-
5.	Programme volume	According to the decision of the Study Quality Commission No. 2022/02-I of 19.01.2022, a variant of the programme in the amount of 60 credit points was added.	-
6.	Form, type, duration of programme implementation	According to the decision of the Study Quality Commission No. 2022/02-I of 19.01.2022, the study duration for the 60 credit point version of the programme is 1 year 6 months for full-time studies and 2 years for part-time studies.	-

7.	Language of instruction		Updated to the Latvian and English languages. The programme was previously also accredited in the Russian language, which was removed up to *Article 49 of the Transitional Regulations of the Law on Higher Education, according to which it is prohibited to enrol students for studies in Russian after January 1, 2019.*
8.	Place of implementation		-
9.	Director of the study programme		Changed to prof. Dr.sc.ing. D. Pavlyuk

10.	Admission requirements	Due to the addition of the 60 credit point programme option, the admission requirements have been clarified. Requirements have been added for the applicants with a background in economics, management, logistics, finance, business and other fields but with at least 1 year of professional work experience in the field of ICT.	-
11.	Awarded degree	According to the decision of the Study Quality Commission No. 2022/02-I of 19.01.2022, the degree to be awarded has been changed to "Master of Science in Computer Systems", based on paragraph 5.2 of the Cabinet of Ministers Regulation No. 322 "Regulations on the Latvian Classification of Education".	-

12.	The goal of the study programme	Modified according to the changed title and content of the programme, taking into account the changes in the demand of the contemporary labour market and current trends in the field of computer science.	--
13.	Tasks of the study programme	Modified according to the changed title and content of the programme, taking into account the changes in the demand of the labour market and current trends in the field of computer science.	--

14.	Learning outcomes	The learning outcomes have been clarified according to the goal of the programme, the updated study course results and the requirements of European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) for level 7, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.	
15.	Final test	-	-

Changes in awarded degree and study programme's classification, in study programme's duration, in study programme's entry requirements

With the decision of the Study Qualification Commission of January 19, 2022 No. 2022-02/1, the degree awarded in the program was changed to Master of Natural Science in computer systems, code 483, according to 02.10.2018. and 09.11.2021. amendments to MK regulations no. 322 "Rules on the classification of education in Latvia", which determines the expiration of the previous code 481 of the program.

With the same decision the program has been supplemented with a short version of the program in the amount of 60 CP, taking into account that according to Article 57 of the Law on Higher Education Institutions, the total duration of full-time bachelor's and master's studies is not less than 5 years. The amount of TSI academic engineering and natural sciences programs is 160 CP. The same approach to program is also foreseen in the University of Latvia (LU) and several higher education institutions, as well as in the second-level professional higher education programs. The short version of the program in the amount of 60 KP ensures the competitiveness of the program in the Latvian educational services market.

Admission requirements for applicants who have not obtained an appropriate bachelor's degree in the field have also been added. The new admission rules provide the possibility to join the study program not only with bachelor’s degree in computer science, but also for graduates with degree in other scientific field, who have worked professionally in the field of ICT for a certain period of time for at least 1 year. In this case, an additional requirement is set - interview with the director of the study program and an entrance exam for the specialty. Such an opportunity strengthens and promotes the interdisciplinary format of the study process, ensuring a connection with practical real life, and the high motivation of such "non-profile" students.

Changes of the study programme’s structure

The programme is taught in two variants – with a specialisation in software engineering and with a specialisation in data analytics and artificial intelligence.

The variant of the programme with specialisation in data analytics and artificial intelligence is taught in a double degree format with UWE Bristol, and this change in the structure of the programme was approved very recently by the decision of the Study Quality Commission of January 19, 2022. The specialisation was developed based on 1) the experience of the University of the West of England (UWE) in the implementation of the Data Science study programme, 2) the review prepared in 2020 by the international distance education platform "Coursera" on the necessary knowledge and competences in the field of data science, as well as taking into account the students’ skills required by the industry.

The structure of the software engineering specialisation has also been significantly improved, it has been supplemented with modern courses covering new areas of computer science: computer vision, cyber security, etc.

The structure of both specialisations has been discussed with representatives of industry partners (for example, Deloitte, Accenture, etc.) and recognized as appropriate for current and future market requirements.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The Master programme "Computer Science" is included in the education programme group 483

“Computer systems, databases and computer networks” of the Latvian education classification (Regulations on Latvian education Education Classification, No. 322), which is a part of the education thematic area “Computer Science” (Datorika) of the thematic group “Natural Sciences, Mathematics and Information Technologies”.

The programme name directly confirms that the programme belongs to the thematic area, since the study courses belong to the corresponding field of science "Computer science and informatics" according to the Cabinet of Ministers Regulation No. MK 595 of 27.09.2022 "Regulations on groups of scientific branches, scientific branches and sub-sectors of Latvia", and covers the following sub-sectors of science:

- Data Mining, the subfield of science – Theory of intelligent systems
- Project and Requirements Management, the subfield of science – Computer and systems software
- Cybersecurity and data protection, the subfield of science – Other subfields of computer science and informatics
- Modern Database Technologies, the subfield of science – Other subfields of computer science and informatics
- Modern Software Engineering, the subfield of science – Computer and systems software
- Artificial Intelligence, the subfield of science – Theory of intelligent systems
- Big Data, the subfield of science – Theory of intelligent systems
- Programming for data analytics, the subfield of science – Computer and systems software
- Mathematics for data analytics, the subfield of science – Mathematical foundations of computer science
- Quality Models of Software and Information Systems, the subfield of science – Computer and systems software
- Computer Vision and Image Processing, the subfield of science – Theory of intelligent systems
- Advanced Artificial Intelligence, the subfield of science – Theory of intelligent systems
- Machine Learning and Predictive Analytics (B2), the subfield of science – Theory of intelligent systems

Therefore, the Master programme "Computer Engineering and Electronics" fully corresponds to the field of study " Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Informatics ".

Association of the study programme with the educational programme group 483 “Computer systems, databases and computer networks” is based on the programme’s learning outcomes, the scientific area of study courses, and the directions of master thesis research.

The programme is assigned to the education programme group 483 of the Latvian education classifier (Regulations on Latvian education classification, Nr. 322), which is “Computer systems, databases and computer networks”, which is a part of the education thematic area “Computer Science” (Datorika) of the thematic group “Natural sciences, mathematics and information technology”. The programme name directly matches the assigned thematic area, while the education programme group is selected for the best match of the programme learning outcomes.

The aim and objectives of the master programme “Computer Science” as well as the learning outcomes correspond to the seventh level of the Latvian Education Classifier.

The tasks of the study programme are aimed at achieving the programme objective “to prepare computer science specialists at a high international level, who can independently learn and apply emerging technologies and best practices of software engineering and data analytics, critically analyse them, design and implement new solutions based on the latest advances in computer science, and also to apply soft skills to work in scientific and professional interdisciplinary projects and to realize themselves on the labour market" and ensuring the study results.

The learning outcomes of the study programme are formulated using a student-centred approach, defining in a structured and detailed manner the knowledge, skills, and competencies that the student possesses and which the student can use and implement after graduation. A list of learning outcomes includes competencies in critical thinking, teamwork and leadership, research, professional development, context awareness, data proficiency, and professional expertise in software engineering and data analytics and artificial intelligence.

The study programme Computer Science is aimed at preparing computer science specialists with advanced knowledge in the field of software development and data analytics. Graduates of the programme can work as senior software developers, software engineers, IT project managers, data analysts, data scientists, applied machine learning engineers, analytics managers/data science leaders, consultants in the field of data analytics and artificial intelligence, researchers in the field of software engineering and data science. Implementation of the study programme is focused on students' skills in applying the latest IT technologies and developing their competencies in line with the demands of the global labour market.

The mapping of the study course (Annex 4.3) for the achievement of the learning outcomes of the study programme provides an in-depth analysis and specification of the learning outcomes of individual study courses.

The admission requirements are determined in the TSI Admission Regulations and are based on regulatory acts: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the regulations of the MK of October 10, 2006 No. 846 "On Requirements, Criteria and Procedures for Admission to Study Programs".

According to Article 57 of the Law on Higher Education Institutions, the total duration of full-time bachelor's and master's studies is not less than 5 years. The programme accepts enrollees with:

1) with a bachelor's degree in natural sciences in computer science, informatics, mathematics, or a bachelor's degree in engineering in electrical engineering, electronics, information and communication technologies, where the bachelor's degree was obtained in 3-year studies (120 CP) – for the long programme of 2 years (80 KP);

2) or with a bachelor of science degree in computer science, informatics, mathematics, or a bachelor of engineering degree in electrical engineering, electronics, information and communication technologies or a second-level professional higher education, obtained in 4-year studies (160 CP) – for the short programme of 1.5 years (60 CP).

The admission rules also formulate requirements for enrollees who have a bachelor's or a second-level professional degree in study areas that are not mentioned above – in economics, management science, logistics, finance, business and other related fields, with at least 1 year of professional experience in the field of ICT. In this case, the enrolee is scheduled for an interview with the director of the study programme and must take an entrance exam in speciality as stated in Appendix 1 of the Admission Rules. Such an opportunity strengthens and promotes the highly demanded STEM qualification, ensuring wider networking and higher motivation of the students.

Appendix 1 of the TTI Admission Rules "Admission procedure to Master programmes for applicants with a background that does not correspond to the field of study of the programme" (https://tsi.lv/wp-content/uploads/2023/01/uznemsanas-noteikumi-2023-2024_eng.pdfpdf).

The study programme is implemented in Latvian and English. Foreign applicants are matriculated based on an internationally recognized testing institution's test score of at least B2 level or the TSI entrance exam in English at least B2 level, except for cases where the previous education was obtained in English.

Such preparation of the applicants in their previous education, motivation to acquire higher education and organisation of the study process at TTI are able to ensure the achievement of the study results of the programme and to award the Master of Science degree in Computer Systems upon graduation from the programme.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

This study programme belongs to the area of information and communication technologies (ICT), which is defined as one of five smart specialization areas with the greatest research and innovation potential in the Smart Specialization Strategy for Research and Innovation (RIS3) of Latvia. Master programmes are the main source of research and innovations, and this programme contributes to the economic transformation towards higher added value and international competitiveness of Latvian economics. ICT is not only a smart specialisation of Latvia but also one of the most emerging economic areas worldwide, which opens access to the programme graduates on the international labour market.

According to the informative report of the Ministry of Economy of the Republic of Latvia (Economic Development of Latvia, 2020, https://www.em.gov.lv/en/media/4499/download), medium- and long-term forecasts of the labour market support the current and future market demand for the programme graduates. ICT is highly significant for Latvian economics not only by itself but by providing a way for the use of digital technologies by businesses and for improving innovation potential. In particular, the report states that “the low share of ICT professionals in the workforce (1.7% compared to the EU average of 3.9%) hampers digitalisation and productivity”. Thus, this study programme contributes to the strategic development of overall Latvian economy. Also, it is worth noting that the specialisation “Data Analytics and Artificial Intelligence” of this study programme are multidisciplinary and focused on the application of modern data analytic tools in a wide range of economic sectors: logistics, finances, construction, etc.

Another report by the Ministry of Economy, “Correspondence between labour demand and supply” (https://prognozes.em.gov.lv/en/correspondence-demand-supply), reveals a huge shortage of labour forces with tertiary academic education in the ICT area. In 2022, the immediate shortage of such specialists is stated as 1494, while in 6 years it will grow to 3587 positions, which forms 22% of the total market demand of 16291 positions. Covering this shortage is a critical factor in the further economic growth of Latvia.

It is worth noting that even though the mentioned reports mostly do not distinguish between bachelor and master specialists, according to industry surveys the latter play a crucial role in innovations and development of the products with high added value. The development of such products and services is also defined as one of the smart specialisation and development directions for Latvia.

This master’s programme is one of the oldest and most well-established study programmes of the Transport and Telecommunication Institute, and its graduates are constantly in demand by industry. According to the state the Monitoring Tool of Higher Education Graduates (https://www.viis.gov.lv/monitoringa-riki , only in Latvian), the employment of 2017 TSI ICT graduates is 90.0%, which is significantly higher than the state average value of 85.9%. Based on available national statistics, the employment among the local graduates is complete (100%) and stable. Similarly, the average income of TSI ICT graduates is estimated as 37654 euro/year (with a state average of 27540 euro/year), while the income of TSI ICT masters is 32712 euro/year (with a state average of 24503 euro/year).

There are a limited number of master’s study programmes in the computer science area in Latvia. In addition to this programme, the most notable programmes are the “Computer Science” academic master programme of Latvian University (LU), the “Computer Systems” of the academic master programme of Riga Technical University (RTU), and, in some aspects, the “Information Technologies” of Latvia University of Life Sciences and Technologies (LLU). The first distinctive feature of the TSI programme is two specialisations, Software engineering and Data Analytics and Artificial Intelligence, which cover the two most demanded directions of ICT development. The latter specialisation is implemented as a double diploma with the University of the West of England (UWE), which significantly improves the competitiveness of its future graduates in the international labour market. The second important competitive feature is wide entry requirements – in opposite to the competitor programmes, this programme invites enrolees with non-ICT backgrounds (after an additional semester of studies, pre-master), which allows people to change their career paths. Finally, for enrollees with an ICT background, the programme is shorter than competitors (1.5 years versus 2 years), which also increases its market attractiveness.

It can be concluded that the TSI master programme in Computer Science fully corresponds to the modern global trends in the field of ICT and Engineering, as well as the most important directions of the development of the national economy of Latvia by smart specialisation.

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The master's programme "Computer Science" is licensed and accredited full-time and part-time in Latvian, Russian and English.

International students until now were enrolled to study in English and Russian, and many foreigners, predominantly from the former Soviet countries, took the opportunity to study in Russian. Amendments to the Law on Higher Education Institutions prohibit the admission of students to study in Russian after 1 January 2019, and the year 2022/2023 is the last year when studies of the program are still conducted in Russian. Students are aware of this, and if for some reason the program is not completed, students will be offered the opportunity to continue their studies in Latvian or English.

The graphs in the appendix show that after steady growth through 2019/2020, the number of students in the program declined in recent years. In the last year, only a couple of students were enrolled. It was influenced by two factors: the above-mentioned amendments to the Law on Higher Education Institutions and the Covid 19 pandemic, which created additional obstacles for international students to study in Latvia.

Last year, due to the improvements made in the program, as well as due to the introduction of the double degree format, 12 students applied for studies, of which 6 - are studying in a double degree format in 2022/2023.

As of 2017, there was a relatively stable interest among potential international students. Despite the fact that the study program is also accredited in Latvian, studies have so far been conducted only in English. This fact is mainly explained by the international nature of the ICT industry in general and the international orientation of this study programme, as well as the wide range of IT programmes offered at Riga Technical University and the University of Latvia, where students have access to state scholarship. This proves a consistently stable interest in the TSI study programme and the topicality of the programme itself, taking into account the impact of the ICT sector on the economy.

Dropouts account for around 17%-20% annually. Statistics show that students drop out of their studies due to failure (this is the main reason for international students) or tuition fee debt, or in some cases it was their own decision. Statistical data indicate that there are often cases when a person does not resume studies after academic leave.

Summing up, we can say that the study program has overcome the impact of negative factors and has the potential to increase the number of students in the next accreditation period. The main positive drivers are: 1) the new specialization (Data analytics and artificial intelligence) with limited admission requirements that attract students without special education, but with ICT work experience. In September 2022, 6 students were enrolled who first have completed the preparatory semester (Pre-master) 2) double degree in cooperation with UWE Bristol, which improves the international recognition of graduates and ensures excellence in the field of study; 3) mixed study mode for full-time studies, which makes intensive studies more convenient for employed students; 4) a short version of the program (1.5 years) for students with a completed program in the amount of 160 CP, which makes the program more competitive in the labor market.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

Not relvant

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study programme is developed under Regulation No. 240 of the Cabinet of Ministers of 13 May 2014 on the National Academic Education Standard (the compliance is provided in Annex 4.2). The study programme is developed in line with the study direction, taking into account the mutual relationships of the study courses. This allows for achieving the goal of the study programme and provides a set of knowledge, skills and competencies in accordance with Level 7 of the European Qualifications Framework of Latvian Education Classification.

The correlation of the goals and results of the study programme with the results of individual study courses can be found in each study course description, which provides a description of the course content, the elaborated course plan, course learning requirements, outcomes, study course evaluation methods and criteria, and the literature and other sources to be used.

This study programme is a classical academic programme that combines the development of high-level competencies like critical thinking and leadership, advanced theoretical concepts like modern data processing algorithms and data warehousing and emerging computer science directions like advanced machine learning. The programme domain is highly international and students of the study programme obtain competencies demanded on the international labour market.

The study programme has two variants, short (60 credit points) and long (80 credit points), and two specialisations: 1) Software Engineering and 2) Data Analytics and Artificial Intelligence.

The core part of the short programme is covered by 7 study courses of 24 credit points in total, and each specialisation additionally includes 4 courses of 16 credit points. The master thesis of 20 credit points concludes both specialisations. The long variant of the programme additionally includes the pre-master semester of 1 core course (6 CP) and 3 specialisation courses (14 CP). The structure of the study programme is presented in Fig.1.

Graduates of master programmes are the main drivers of innovations in economics and their ability to create new products and services with high added value is crucial for Latvian economic development. The core learning outcomes of the study programme develop these competencies: critical thinking, research and teamwork and leadership (learning outcomes LO1, LO2, and LO3). The competencies are covered by specially designed courses: Critical Thinking and Innovation, Research Methodology and Project and Requirements Management. Another “must-have” competence of the masters in the fast-changing computer science domain is their ability to further professional development and independent life-long education, which is continuously covered by all programme courses (LO4).

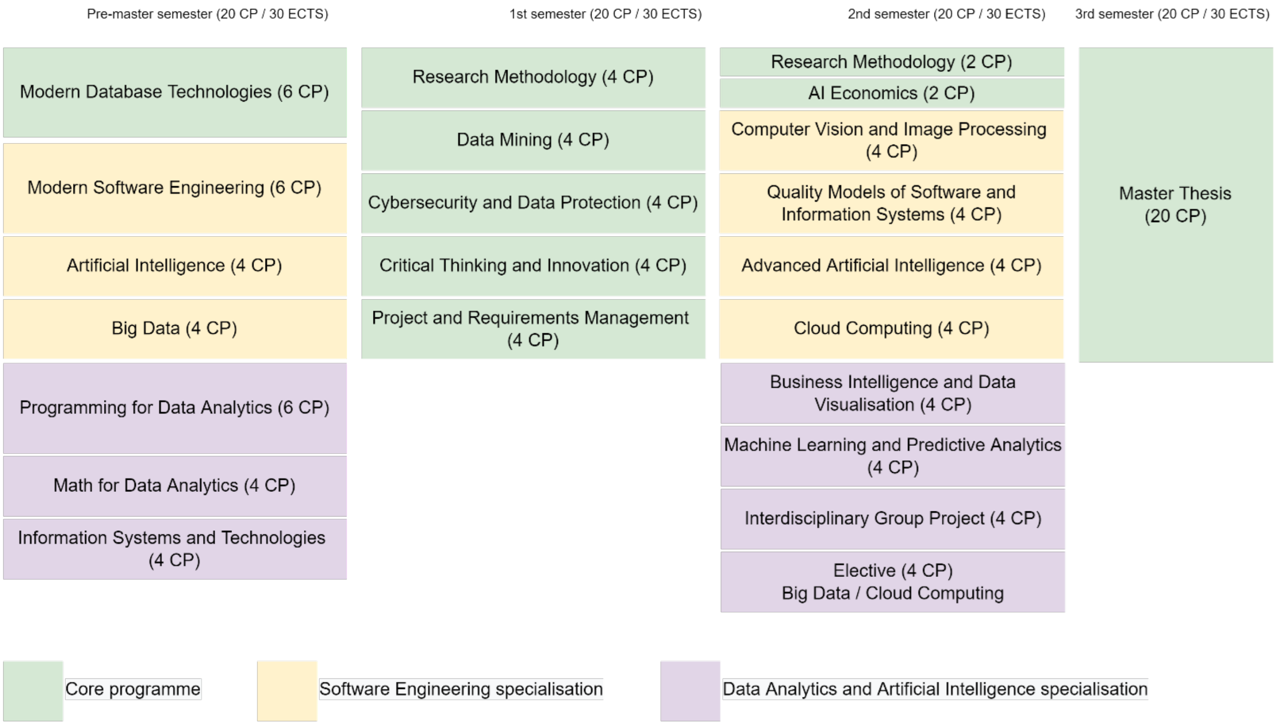


Fig. 1. Structure of the study program

Software products play an important role in all aspects of our lives, thus the masters of this study programme, who design and develop new software solutions, should be aware of the context of their job results. The context includes an understanding of economic, social, ethical, security and other aspects of modern software solutions and this competence is covered by the courses on Cybersecurity and Data Protection and AI economics (LO5).

Data is the core component of any modern software and is widely acknowledged as the new oil. At the same time, according to a survey of 1,500 global business leaders (Seagate Technology, Rethink Data report), 68% of data goes unleveraged. Thus, the competency of data handling and utilising is crucial for computer science masters. Development of this competency is an important outcome of this study programme, covered by the course on Data Mining, Modern Database Technologies, Big Data and specialisation courses (LO6).

Two specialisations of the programme, Software Engineering and Data Analytics and Artificial Intelligence, correspond to two directions of the fastest growth of computer science. High-level specialists in these areas are in high demand on today's labour market, and this demand will grow in the next decade. The high current demand for these specialists is supported by high salaries in this area. According to the Big Cloud Salary report (2022) and several other industry reports, the median salary of software engineers is about 2 times higher than the overall average in European countries and UK, and the median salary of data analytic specialists (data engineers, data scientists, machine learning engineers, etc.) is 3 times higher. The highest demand for specialists is observed in ICT, Consulting, Manufacturing, Healthcare, Transport/Logistics, FinTech and Defence industries. In terms of the Latvian economy and labour market, huge growth is expected in the next decade. According to the European Commission report (2020), only 2% of Latvian enterprises use the potential of data analytics and artificial intelligence for operating their businesses. Taking into account the average level of 7% in European countries, including more than 20% in the leading country, Ireland, huge progress is foreseen and growing demand for the study programme graduates is highly expected. Concluding, the learning outcomes of the programme's specialisations which includes professional competencies in software engineering (LO7) and data analytics and artificial intelligence (LO8) are in high industry demand in nowadays market and market forecasts. This fact is additionally justified by the extensive support of the programme from industry – by Deloitte, Accenture, and other largest Latvian employers.

The specialisation-specific learning outcomes are covered by specialisation courses: Advanced Artificial Intelligence, Computer Vision and Image Processing, Quality Models of Software and Information Systems and Cloud Computing (for Software Engineering) Business Intelligence and Data Visualisation, Machine Learning and Predictive Analytics, Interdisciplinary Group Project, and Big Data / Cloud Computing elective (for Data Analytics and Artificial Intelligence). Since the programme specializing in Data Analytics and Artificial Intelligence are implemented in the form of a double degree diploma, its study results and the study courses were developed in close cooperation with the partner university UWE Bristol, including a double quality control by TTI and UWE, assessing the relevance of the programme to the European and UK labor market.

The distinctive feature of the programme is the long variant that is designed for students, who are going to change their career path to the computer science direction. Facing the high market demand and shortage of specialists in this area, the attraction of students with other backgrounds is beneficial in terms of labour markets. The long variants include an additional pre-master semester, which covers the most important skills: Modern Software Engineering, Artificial Intelligence and Big Data (for Software Engineering), Mathematics for Data Analytics, Programming for Data Analytics, and Information Systems and Technologies (for Data Analytics and Artificial Intelligence). These courses are designed to enhance non-ICT students' competencies with the most useful tools and technologies (Python programming, modern optimisation, AI and Big Data models, etc.) that will allow students to complete the core study programme.

Ongoing support of the actual state of the study programme is ensured by the vision of the program-leading professors, industry professionals and experts. In addition to the elected programme professors, invited lectures and workshops from internationally recognised professors, researchers and industry representatives are widely used in TSI. The content of the study courses and their relevance are reviewed every year during the annual self-evaluation of study programmes by the TSI Study Course Management Regulations. As a result of the self-assessment, a programme development plan, which includes the necessary updates of study course descriptions according to the development trends of the industry, labour market and science, is regularly updated. Student feedback is also collected by a bi-annual evaluation survey and taken into account in a form of the opinion of graduates and their employers, who provide their input for the latest developments and current trends in the labour market. The updated study courses are coordinated, approved and included in the Register of Study Programs and placed into the learning environment.

3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

The master study programme strictly follows emerging scientific and industry trends and tries to forecast them. The content of the study programme is designed in a way that the emphasis is placed on applied research in the emerging areas within each study course. Matching of the study course content and the emerging trends is facilitated by the active practical, scientific and research activity of the programme academic staff – participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities. TSI elected professors that designed and will participate in the implementation of the study programme (profs. Irina Jackiva, Igor Kabashkin, Mihails Savrasovs, Alexander Grakovskis, Boris Mishnev, Dmitry Pavlyuk, Nadezhda Spiridovska) are well-established scientists and active researchers, who are constantly involved in the implementation of top-edge research projects, participate in international conferences and publish in top scientific journals.

The relevance of the study courses is also ensured by a proportion of faculty members recruited from the industry who are elected to academic positions at TTI or are invited to conduct individual courses. For example, prof. Jelena Kijonoka is employed at Accenture Baltics as Senior Data Scientist and delivers the Advanced Artificial Intelligence and Machine Learning and Predictive Analytics courses; prof. Neil Rubens, who is employed at the VISA Corporation and delivers the course on Big Data; Jelena Revzina is employed at iPro IT service integration company and delivers the course on Cybersecurity and Data Protection; prof. Emmanuel Merchan is employed at Robotic Solutions and manages the Interdisciplinary Group Project.

Industry experts and guest lecturers involved in the study process also make a significant contribution to the education of master's students, as they provide feedback on the need to improve the study process, as well as point out current aspects of the business environment. Therefore, students have the opportunity to acquire practical skills that will be needed in the labour market.

The relevance of the course content to the new trends is promoted by the active practical, scientific and research activities of the programme's academic staff – participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities. The faculty members of the TTI involved in the implementation of the study programme (Prof. Irina Jackiva, Igors Kabaškins, Mihails Savrasovs, Aleksandrs Grakovskis, Boriss Mišņevs, Dmitry Pavlyuk, Nadežda Spiridovska) are recognised scientists and active researchers who are constantly involved in the implementation of the research projects, participate in international conferences and publish in leading scientific journals.

TSI has a strong alumni community that also provides the most recent advances to students of the master study programme and contributes to the study course content. For example, TSI alumni Ilya Jackson who currently holds the position of postdoctoral fellow at Massachusetts Institute of Technology (MIT) and Aleksejs Truhans, software engineer and tech lead at Google, conducted their lectures in September-October 2022.

Another valuable source of information about recent trends in cooperation projects of the TSI Data Analytics and Artificial Intelligence research cluster. The cluster conducts data-based research, consultancy and training, including big data analytics, statistical modelling, natural language processing, and major aspects of artificial intelligence, filling the gap between cutting-edge research and businesses across industries and sectors. For example, the recent projects of the cluster were conducted for the Mediterranean Shipping Company (in the area of logistics) and My3D.Cloud (3D scanning). TSI professors, who participated in these projects, utilize the identified business requirements for designing the study courses and the programme.

The Master programme is ended by the elaboration and defence of a Master thesis. The academic Master degree in Computer Systems is awarded for a publicly defended Master thesis, which is an independently developed work under the supervision of a leading faculty member, contains original research results and provides new insights into the relevant field of computer science. As a part of the master theses, the students carry out quantitative or qualitative research, justifying the novelty of the research and contributing to the development of science.

After completing the programme in a double degree format, in addition to the degree awarded by the TTI, students will be awarded the MSc Computer Science: Data Analytics and Artificial Intelligence from UWE Bristol. It is also possible to obtain the UWE Intermediate Diplomas – PGCert Computer Science and PGDip Computer Science.

In general, the content of the Master's study programme "Computer Science" is updated according to the development trends of the industry, labour market and scientific development, providing the opportunities to acquire in-depth knowledge of information and communication technologies, as well as the use of these technologies in various contexts, therefore, ensuring the interdisciplinary approach that is so necessary nowadays.

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study process is mainly implemented as a combination of interactive lectures, practical workshops (discussions, project teamwork, seminars, computer labs, etc.) and independent studies. A split between these components depends on the study course learning outcomes and is selected by the leading professor after a discussion with faculty members. Generally, selected implementation methods are geared toward the development of the student's learning abilities, creative use of knowledge, cooperation, self-evaluation, critical thinking and making responsible decisions. Designed implementation methods for each course are specified in the course description and provided to students at the beginning of the course.

TSI promotes the selection of modern methods of teaching, so the study courses are implemented using case-based learning, learning-by-doing, using MOOC as an additional study tool, project-based learning, flipped classrooms, and others. For example, the AI Economics study course is based on case studies (own professor's cases and TSI subscription to Harvard Business Review cases), discussed and solved by students; the Programming for Data Analytics study course utilises MOOC courses (TSI subscription to Coursera) for levelling the skills of pre-master semester students; the Modern Database Technologies course includes multiple learning-by-doing components; the Interdisciplinary Group Project is completely based on developing real-world projects, provided by the industry partners.

Blended learning is widely used for the study process implementation. This approach integrates traditional classroom activities with technology and digital media, giving students more flexibility to customize their learning experiences. Students are provided with video recordings, online quizzes and access to virtual platforms (e.g., Google Colab) for improving the achievement of learning outcomes. The study schedule is developed in a convenient way (evenings and Saturdays), which is crucial for working master students. A hybrid mode (combination of students, participating in face-to-face and remote modes) is also used for a share of theoretical classes. Every study course is organized via the TSI learning management system (Moodle), which integrates all the course-related materials, additional resources, and virtual services. Moodle is also used for collecting all students' work results, grading, and feedback collection.

The basic principles and procedures for the evaluation of the study programme completion comply with the requirements of Article 40 of the National Standard for Academic Education. According to the provisions of the TTI Study Procedures, the study results in the academic bachelor study programme are evaluated according to two evaluation criteria: the qualitative criterion – a grade in the 10-point system, and the quantitative criterion – credits points based on the total number of hours in the study course. The complex method is applied for the assessment of the results of the study courses. It includes the assessment of students' practical work, individual or group work, intermediate examinations and final examinations (tests or examinations). In order to encourage the students' continuous work, it has been established that the final examination mark makes up at a maximum of 50% of the final grade of the course. At the beginning of the semester, students are informed how the final result (grade) will be determined.

Each course has a complex assessment system, described in the course description and carefully explained to students at the beginning of the course. All courses use a summative assessment approach, so that a student's final grade consists of the interpretations of all test forms assessments (assessments on presentations, practical work in the computer lab, essays on situation analysis, homework, etc.) and one or two final components (e.g. final exam, final project presentations, etc.). Each component is linked to its contribution to the final grade (percentage) and to the grading rules (e.g. performance grading rubrics). The summative assessment approach allows for an even distribution of the student workload during the semester and reduces student stress during the final examination. In addition to summative assessment, several courses use formative assessment tools (using assignments with extensive feedback, quizzes, automated tests, etc.) to monitor students' progress and to provide continuous feedback. The development of the evaluation structure is a complicated problem, which is solved in intensive discussions among faculty members.

The assessment process is organised to comply with the requirements of Article 40 of the National Academic Education Standard, adopted by the TTI Senate. Each course has a complex assessment system, described in the course description and carefully explained to students at the beginning of the course. All the courses use the summative approach to assessment, so the final grade of a student adds up from multiple in-semester components (e.g., grades for presentations, computer practices, essays on case studies, home works, etc.) and one or two final components (e.g., final exam, final project presentations, etc.). Each component is associated with its contribution to the final grade (percentage) and grading rules (e.g., rubrics). A summative approach to assessment allows uniformly distributing of students' efforts within a semester and reduces students' stress at the final exam. In addition to summative assessment, several courses utilize formative assessment tools (using assignments with extensive feedback, quizzes, automated tests, etc.) for monitoring students' progress and providing ongoing feedback. The design of the assessment structure is a complex problem, solved by intensive discussions among the faculty staff members.

The Data Analytics and Artificial Intelligence specialisation are provided in a form of a double diploma with UWE, so the study process and the assessment structure are synchronised with UWE Study Regulations (available on the UWE Bristol website: https://www.uwe.ac.uk/-/media/uwe/documents/about/services/academic-regulations-tsi.pdf). In addition to the study and assessment principles, the regulations define the process of validation and approval of all assignments and post hoc analysis of obtained results, including a review of the grade distribution. The procedure is routinely repeated before the beginning and after the end of every semester.

The study methods contribute to the achievement of the study course and the programme learning outcomes and are based on student-centred education principles to encourage students' active participation in the study process and ensure appropriate assessment of student achievements. According to Harrington and DeBruler (2019), student-centred education principles include 4 components:1) voice of students, 2) choice of students, 3) competency-based progression, and 4) continuous monitoring of student needs. All the principles are carefully covered by the study and assessment processes, described above. Generally, the principles of student-centred education are the same for all TSI study programs and are described in more detail in part 2.3 of the description of the bachelor's programs in Computer Science of the study direction.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The master's programme in Computer Science, as well as all other TSI master's programs, includes the mandatory study course "Research Methodology" of 6 credit points, which is aimed at an active discussion of possible topics of the master's thesis. During the course, the student is provided with information about potential topics of the master thesis, which are offered by both TSI teaching staff and TSI partner companies (Accenture Baltics, Deloitte Latvia and others) and prepares a thesis proposal by analysing the current situation in the field of research (state of the art). Topics of TSI professors usually match their research directions (e.g. algorithms of data analytics, modelling advances, signal processing, etc.); topics of industry representatives reflect current needs of the industry (e.g. Accenture Baltics publishes potential bachelor's and master's thesis topics every year and offers consultants from their company).

Despite a wide range of proposed topics, the majority of students decide to propose their ones, based on their research interests or current occupation. Last-semester master students have good skills for independent research and proposal of their own ideas, and TSI widely supports and provokes this approach to the selection of a master thesis topic. This way students are provided with the opportunity to develop a master's thesis in an actual scientific and practical field. Student proposals are carefully reviewed in two aspects: the novelty of the topic and the ability of faculty members or invited professors to supervise the work.

Topic examples of defended master thesis are provided in Annex 4.8. The topics can be conditionally classified into 3 groups:

- Advances in software engineering (e.g., "Methodology of recovering C++ structures from native PE format files of x86_64 architecture" by Ričards Dzenis, "Task Offloading in the Internet of Things via Deep Reinforcement Learning" by Oleg Borovik)
- Comparison and development of new algorithms (e.g., "Comparison of modern methods of query optimization when working with relational databases" by Eduards Grūberts, "Study of the Hybrid Method K-Means and TadGAN model for Time Series Anomaly Detection" by Veronika Grundmane)
- Application of modern models to emerging domains (e.g., "Human Activity Recognition with Smartphone Sensors using Machine Learning Algorithms" by Dmitrijs Balabka, "Human face transformation from a single photo using Generative Adversarial Network" by Aleksandrs Paļko)

These groups were naturally formed from the flexible topic approval process, described above, and used for introducing two specialisations of the study programme.

Another important step of master thesis topic validation is its presentation at a scientific conference. Conference participation is a mandatory prerequisite for defending the master thesis and it allows students to obtain early feedback. Students of all TSI master study programs present the results of their research work at the student scientific conference "Research and Technology – Step into the Future (RaTSiF)", which is organised twice a year by the university – in December and April. The conference's objective is to promote the professional development of students in parallel with the acquisition of the theoretical material of the study course, acquiring scientific research skills in the methodology of research, the choice of research methods, the collection of theoretical knowledge of science, the execution of practical research, the ability to acquire, analyse and interpret research data, as well as to express the obtained research results in reasonable and understandable conclusions; to promote students' scientific creativity, thus strengthening the connection between studies, practice and scientific research activity. Thus, the novelty of the obtained research results and their relevance to the field of the study programme is evaluated. After the conference, students are given recommendations for further work.

The final master theses are uploaded to the TSI Final Thesis portal and evaluated by the supervisor. The supervisor evaluates the work and provides comments on the work process. The following criteria are used: compliance of the work content with the set goal and tasks; relevance of the conclusions to the set tasks; level of use of literature and other sources of information; compliance with the work development schedule; presentation according to the requirements; execution of supervisor's instructions.

All master theses are reviewed. The reviewer is usually a leading TSI professor who has practical or scientific experience in the subject area. The following criteria are used: the purpose of the work and hypothesis/tasks; level of use of literature and other sources of information; research methodology; analysis of results; conclusions; work organization, and style; as well as the overall assessment of the work. To increase the objectivity of the evaluation and ensure students' understanding of their thesis's evaluation, a rubric (performance evaluation scale with a textual description) is used.

Final theses are defended in front of the commission, which is formed from leading TSI professors and chaired by a representative of employers with a doctoral degree. The commission evaluates the following criteria: relevance of the work to the chosen topic (by volume and content); ability to apply the knowledge, skills and competencies; ability to organise the thesis text according to the requirements; ability to present work. Each member of the commission evaluates the master thesis and the defence itself independently, and the commission makes the final decision by majority voting.

The described procedure allows ensuring the relevance of master thesis topics, their novelty and consistency with recent scientific and labour market trends, and the quality of the final works.

Final grades for the master thesis are fairly high (distribution of grades in 2013-2022 is presented in Fig.2.

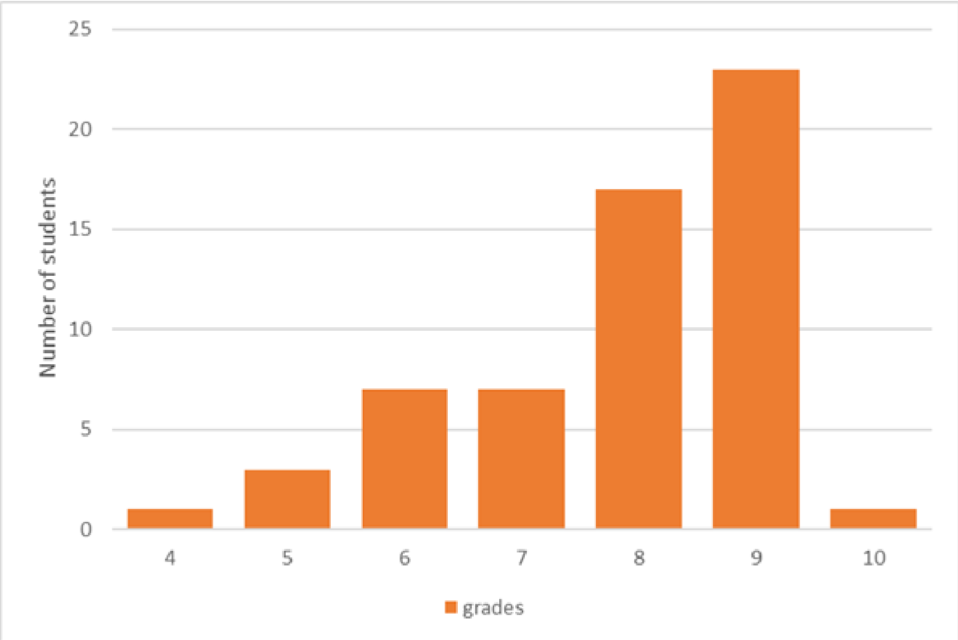


Fig. 2. Distribution of grades of the master thesis

The most frequent grades are 9 (44%) and 8 (33%), with a median of 8 and an average of 7.8. The positive evaluations of master theses correspond to their high scientific quality, the ability of students to present and defend the obtained results, as well as the graduates' preparedness for the labour market. A recent example of a thesis with a grade 9 is Dmitrijs Balabka's thesis "Human Activity Recognition with Smartphone Sensors using Machine Learning Algorithms", which was presented at the top-edge conference 2019 ACM International Joint Conference on Pervasive and Ubiquitous Computing and later won prestigious SHL recognition challenge 2021. The highest grade of "excellent" is awarded only for outstanding performance and international recognition of the results. This confirms the serious attitude of the final examination commission in assessing the performance of each student.

No unsatisfactory grades were provided in the last ten years.

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision,

scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

The study direction report Part II, Chapters 3.1-3.3 contains full information on the resources and provisions. This paragraph supplements the information with additional aspects of the master study programme.

The study process is mainly ensured by the TSI Engineering Faculty staff. The TSI Engineering Faculty provides teaching and methodological work: creates and updates study course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and provides defences of master theses and carries out other activities related to teaching, methodological and scientific work. The TSI Digitisation and Innovation Learning Centre provides methodological support for the development of study courses on the TSI Learning Management System platforms.

For the effective implementation of the study programme, the academic staff and students have access to the auditoriums equipped with the latest generation of video and audio equipment, as well as certified high-class laboratories, which correspond to the specifics of the study programme and the conditions for its implementation.

The TSI library is available for students of the study programme. The TSI library provides access to the Academic Complete database, which is available online to both students and faculty. The Academic Complete database is a scientific e-book database created by the ProQuest company, which contains more than 180,000 book titles in all major scientific disciplines. Students also have access to the Scopus database, which focuses more on scientific publications. The library staff organizes regular classes informing about library news and the use of library resources.

A creative and friendly environment plays an important role in successful master studies. TSI research clusters and labs have all the necessary facilities for research in the computer science domain, providing students with an opportunity to get involved in research activities. For example, the TSI Data Analysis and Artificial Intelligence research cluster, established in 2021, provides its resources and expertise for data-related research of master students; Telecommunications, electronics and robotics centre supports the applied research in robotics; Image Processing, Biometry & Automated Border Control Systems Laboratory provides facilities for research on advanced data collection and processing software and algorithms. Information on opportunities to participate in the projects or other activities is disseminated both on the TSI website and through individual student recruitment, taking into account their desire to gain practical research experience.

TSI resources are not limited by onsite facilities – the importance of cloud services is rapidly growing last few years. Cloud services are intensively used by several study courses. Google Colab is used for practising Python programming; GitHub and Bitbucket are used for collaborative work, AWS and Heroku can be used for cloud database management. TSI supports the usage of cloud services and provides additional access to online educational facilities. For example, an agreement with Coursera was signed in 2022. The purpose of the agreement is to develop cooperation and provide both faculty and students with the opportunity to complete specific courses from the Coursera catalogue. For the teaching staff, it is an opportunity both to improve their qualifications and to use Coursera courses in the study process. This agreement also provides the ability to develop courses using Coursera tools. Currently, Coursera courses are used for levelling the Python programming skills of students within the pre-master semesters: students have different educational backgrounds, and the gaps, identified by the leading professor, are covered by Coursera courses. This practice will be extended in the next semesters.

During their studies, students who study in the double degree programme have access not only to TTI resources, but also to the resources of UWE Bristol, for example, the e-library.

The scientific, informational, material-technical and financial base of TSI ensures prerequisites for the achievement of study results and indicates the possibility to ensure a high-quality study process for the study programme.

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Starting from the foundation, income from tuition fees is the main source of funding for the study process at TSI. The study programme is financed from the financial resources of individuals and legal entities.

In the 2022/2023 academic year, the tuition fee for one full-time student is 2,400 euros per year, for a part-time student - 1,920 euros per year in the double diploma program. The amount of tuition fees for each academic year is determined and approved by the rector's order. The study payment procedure is determined by the Regulations on the study fee payment procedure, where the possibility of paying the study fee is provided for the entire study programme as a whole, for one study year, for one study semester or as a monthly payment (starting with the 2nd semester).

The average costs are presented in Appendix 4.7. There is no difference in the cost of studying in Latvian and English, since the implementation of studies is ensured at a high quality level without a breakdown by language of instruction, therefore no different study fees have been determined. The tuition fees are different for the double degree programme – EUR 4900 per year – because, among other things, there is a double assessment system. The results of all study courses in the programme are assessed first by the TTI and then by UWE Bristol staff.

In 2021/2022 ac. year, the cost structure of the study programme splits to 55% to salary and taxes (including scientific publication and other payments, by TSI teaching staff salary regulations), 5% to study programme development and implementation, 9% for teaching materials and other similar costs, 14% to scientific infrastructure and other similar costs, 2% for advertising and marketing costs, 6% to infrastructure (including IT) costs, 7% to depreciation and amortization, and 2% to other administrative costs.

Every year, TTI gives students the opportunity to receive personalized discounts for full-time studies in the amount of 50%, 75% and 100% of the tuition fee, discounts are awarded by tender.

In order for the programme to be profitable, there must be at least 6 students in the programme.

It is taken into account that study course programmes follow the sequence of study courses, as well as the study plans of each programme are coordinated with each other – the study courses included in the plan and their sequence by semester. For example, all Master’s level programs teach the study courses “Research Methodology” and “Critical Thinking and Innovation” to develop research skills and critical thinking.

6 students is indicated as an average number, since as it has already been mentioned, several courses are taught jointly for different programmes. The costs for the full-time in-person study programme in the amout of the 80 CP are higher, therefore, more students are required for this programme - 7 people, part-time face-to-face - 5 people. The language of study does not affect the amount of costs.

Thus, funds are saved, programmes become profitable with a smaller number of students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

Teaching of the study program is provided by 13 teaching staff members with relevant academic work experience and qualifications, 11 of whom are lecturers elected by TTI.

8 TTI professors and 1 associate professor are involved in the implementation of the compulsory and limited optional part of the academic master's programme “Computer Science”, all possessing the degree of Doctor in engineering: Dr. sc. ing. I. Jackiva, Dr. sc. ing., D. Pavlyuk, Dr. hab. sc. Ing. I. Kabaškins, Dr. sc. ing. B. Mišņevs, Dr. sc. ing. I. Pticina, Dr. sc. ing. M. Savrasovs, PhD E.Merchan, Dr. sc. ing. A. Grakovskis, as well as associate professor Dr. sc. ing. N. Spiridovska. Therefore, the qualification of the teaching staff involved in the implementation of the study programme is fully under Article 55 of the Law on Higher Education Institutions of the Republic of Latvia, part 1, which stipulates that no less than five professors and associate professors altogether, who are elected to academic positions in the relevant higher education.

In addition to the mentioned composition of professors, 2 assistant professors are also involved in the implementation of the programme.

All academic staff involved in the programme hold the doctoral degree in engineering.

In the study process, not only the academic staff of the field of study are involved, but also several industry specialists, including foreign teaching staff, who with their professional experience not only deepen the students' practical knowledge and skills within the study course, but also increase the students' employment opportunities after graduating from the programme.

Currently, 3 elected academic staff members work in the industry: as. prof. Jelena Kijonoka is employed at Accenture Baltics as Senior Data Scientist; Jelena Revzina is employed at iPro IT service integration company as cyber security engineer and Cisco Networking Academy instructor; prof. Emmanuel Merchan is employed at Robotic Solutions as a director of engineering. The study course Big data is delivered by visiting professor Neil Rubens, who works at VISA corporation.

Some study courses have several lecturers, or the programme director reads the basic course, but it is already expected that representatives of the industry will be invited as guest lecturers for some topics, thus ensuring both the quality and relevance of the study course content directions.

The knowledge of the national language of the teaching staff involved in the programme complies with MK 07.07.2008. to regulations no. 733 "Rules on the amount of knowledge of the national language and the procedure for testing the national language proficiency for the performance of professional and official duties, obtaining a permanent residence permit and obtaining the status of a permanent resident of the European Union and the state fee for the national language proficiency test". The Personnel Department of TTI makes sure of the national language skills when hiring the staff.

In order to be sure of the English language skills of the teaching staff, TTI periodically organizes an English language proficiency test and, if necessary, additional training, for example, in the 2019/2020 academic year, several of the teaching staff improved their English proficiency level in courses organized within the framework of project 8.2.2.; repeated English language courses are planned from the university's own funding in the future.

Professor E.Merchan and guest lecturer N.Rubens teach only in English in the programme for both students who study the programme in English and students who study the programme in Latvian, taking into account that the university has the right to implement no more than one fifth of the study programme credits in a foreign language (Article 56, paragraph three of the Higher Education Law, Clause 5.1.2 of the TTI Study Agreement).

The qualifications of teaching staff involved in the implementation of the study programme meet all requirements of regulatory acts and ensure the achievement of the goals and study results of the study programme and corresponding study courses.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Changes that occurred in the composition of the academic staff involved in the implementation of the master study programme since the previous accreditation in the academic year 2012/2013 are presented in Table 1.

Table 1. The study programme's academic staff structure

Position	2012 /2013 academic year			2021 /2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professors	8	-	8	8	-	8
Associate Professors	2	-	2	1	-	1
Assistant Professor	2	-	2	2	-	2
Lecturers	-	1	1	-	-	-
Guest lecturers	1	-	1	1	1	2
Total			14			13

The total number of lecturers is almost unchanged, but only 3 professors continue to teach in the program from the last accreditation: prof.i.Jackiva, prof. I.Kabaškins, prof.B. Mišņevs.

During the reporting period, 6 new (elected TSI) lecturers were recruited into the program. Although the total number and distribution of academic staff kept stable, only 3 staff members currently involved in the study programme implementation continue their job from the previous accreditation: prof. I. Jackiva, prof. I. Kabaškins and Prof. B. Mišņevs. During the reporting period, 6 new lecturers were recruited (elected by TTI) to the study programme; they teach a specific study course or part of it.

Several teaching staff have increased their academic work experience and have been elected to higher positions. For example, J. Kijonoka (Jurševiča) taught as a lecturer in the previous period, currently she is an assistant professor. Some of the teaching staff are graduates of different years of study programmes who have obtained a doctorate in science during the reporting period and teach in the master's program: prof. I. Pticina, ass. Prof. J. Kijonoka, prof. M. Savrasovs, associate prof. N. Spiridovska.

Changes in the composition of lecturers are influenced by several factors. One of which is generational change, since many lecturers were in the pre-retirement age group at the time of the previous accreditation. Currently, many young lecturers (up to 45 years old) are teaching in the programme. Several teaching staff have increased their academic work experience and have been elected to higher positions.

The selection of lecturers is determined by the content of the study programme, which is continuously improved according to the rapid development of the ICT industry. The programme includes study courses that provide future competencies and professionals specialising in the field are invited to deliver these courses. For example, J. Kijonoka, who was involved in the study programme implementation in 2012 as a lecturer, obtained a doctoral degree, made a professional career as a data scientist at Accenture Latvia, and now delivers the course within her professional domain of knowledge. The attraction of professionals to the implementation of the study programme ensures a connection of the studies with practical activities and recent market trends and generates higher interest among students.

During the reporting period, TSI made significant efforts in the hiring and development of the academic staff to ensure the quality of the study programmes in the best way. The HR development plan of the faculty was elaborated to provide continuous quality improvement of the study programmes by promoting the professional development of the academic staff, attracting internationally recognized professors, experts and professionals in the field, and foreign guest lecturers.

It can be concluded that the changes in the structure of the academic staff involved in the study programme can be evaluated positively, that the relevant qualifications and experience of the academic staff ensure the high quality of education and are appropriate for the achievement of the overall results of the study courses and the study programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

Cooperation between teaching staff members is implemented at four levels: within a course/set of courses, within the study programme, within the faculty and university-wide.

The within-course cooperation is organised between teaching staff members, leading or implementing the same course or a set of related courses in English or Latvian. This cooperation is usually managed by the leading academic staff (assigned according to TSI regulations to each course) and focused on the improvement of course actuality, learning outcomes and teaching approaches. Course-related group meetings are organised and allow the development of a unified approach to the course implementation for students of English/Latvian language and full-time/part-time forms of the programme. This cooperation is important for the career development of young teaching staff members, who serve as teaching assistants in practical and computer classes under the direct supervision of the leading academic staff.

The within-programme cooperation is implemented in a form of faculty seminars, where interrelations between the programme's study courses and their learning outcomes are discussed and potential improvements are proposed. This cooperation was intensively used during the preparation of the new programme structure and this report. The important within-programme cooperation events are preliminary and final defences of master theses. The preliminary defences are organised with the participation of a committee of faculty members, where the recommendations are collectively made to improve the master theses. Consequently, cooperation between teaching staff members of different fields is ensured and allows developing the unified understanding of the programme's learning outcomes. The same cooperation is observed during and after the final defence of master theses when the Final Examination Commission gives its evaluation as a result of the discussion. The committee is composed of leading faculty members, and the chair of the committee is a company representative (in 2021/2022 it was Dr.sc.ing. Anatoly Plotkin, Specialty Lead at Accenture).

The within-faculty cooperation ensures interrelations between the study programmes of the same level (e.g., Management of Information Systems and Computer Science study programmes) and different levels (e.g., bachelor and master Computer Science study programme). This cooperation allows the development of a common understanding of overall industry trends and is extremely important in a long run. A special form of this cooperation is meetings of the Faculty Dome and study direction board, which invite teaching staff members, TSI business partners (e.g. Deloitte Latvia, Accenture Baltics and others), professional organizations and associations (Information and Communication Technology Association, LIKTA, Latvian Electrical Engineering and Electronics Industry Association, LETERA) and representatives of student self-government to open discussions. The proposal and opinions are carefully documented and used as a base for future changes of the study programme.

The university-wide cooperation is used for supporting a unified interdisciplinary approach to the implementation of the study programmes. This cooperation is implemented via seminars, organised by TSI management, with presentations of novel teaching approaches and open discussion on the study programmes' learning outcomes. Additionally, the self-assessment boards are organised at the university level, where programme directors present potential improvements to the study programme and cooperate with other directors on their synchronisation.

Experienced TSI researchers, including those involved in the implementation of this study programme, also intensively cooperate in the scope of TSI research projects and activities funded by the Latvian Council of Sciences, the European Commission and other international funding sources and foundations in cooperation with partners in universities and research institutions in Latvia, European Union Member States and worldwide. Practical research experience and cooperation within joint research play an important role in improving the learning outcomes of TSI study programmes and their interrelationships.

Since the strategic cooperation agreement with the University of the West of England (UWE Bristol) and the launch of the Master degree programme "Computer Science" in Analytics and Artificial Intelligence in the form of a double degree diploma, active cooperation between the faculty members of both universities has been taking place. The cooperation covers the development and independent improvement of the study courses and the joint assessment of the study results.

Both at the study course and programme level, the learning outcomes are assessed by both TSI and

UWE Bristol faculty members. A representative of the University of the West of England was also involved in the working group for the preparation of the field of study for accreditation. Such cooperation contributes not only to the professional development of the teaching staff, but it is primarily of significant benefit to the graduates of the programme, ensuring excellent quality of education, high teaching standards and 2 internationally recognised diplomas - European Union (TSI) and UK (UWE Bristol).

The total number of teaching staff involved in the implementation of the programme is 13, but the total number of students in full/part-time studies in 2021/2022 was 31, thus the ratio of students to lecturers is 2.2.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annex 4.6 Sample of the diploma.zip	4.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	Annex 4.8 Opinion of the Council of Higher Education.docx	4.8.pielikumsTSI_Mg datorzin_250.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 4.1.Statistics on the students.docx	4.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 4.2. Compliance with the State Education Standard.docx	4.2.pielikums. Atbilstiba akademiskajam standartam 3001.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 4.3. Mapping of the study courses.xlsx	4..3.pielikums. Studiju kursu kartejums CS - LV.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 4.4. The curriculum of the study programme.zip	4.4.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 4.5. Descriptions of the study courses modules.zip	4.5.pielikums. Studiju kursu apraksts.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 4.9 Confirmation.docx	4.9.pielikums. Apliecinajums atbilstiba AL.pdf

Telematics and Logistics (51526)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Telematics and Logistics*
Education classification code	*51526*
Type of the study programme	*Doctoral study programme*
Name of the study programme director	*Igors*
Surname of the study programme director	*Kabaškins*
E-mail of the study programme director	*kiv@tsi.lv*
Title of the study programme director	*Dr.habil.sc.ing.*
Phone of the study programme director	*29215392*
Goal of the study programme	*To train Doctors of Sciences, highly qualified researchers and specialists in the field of Telematics and Logistics, providing the theoretical and practical knowledge necessary for independent scientific research and pedagogical work*
Tasks of the study programme	*• To learn the latest theoretical concepts, fundamental principles, research methods and methodologies of conducting the research in the chosen field. • To carry out scientific research on a chosen topic, using the modern state of the art methods of analysis and data processing. • To develop skills of analytical, creative and critical thinking and the ability to solve problems in an innovative way. • To be able to present the research results at the international scientific conferences and seminars, to be able to prepare and publish the scientific articles on the research results. • To develop the skills of leadership and change management, the ability to work in a team and to collaborate with the professionals from different fields. • To develop the pedagogical skills, to develop independently the courses and to deliver the academic lectures, to supervise the Bachelor, Master or Diploma theses.*

Results of the study programme	*Independently developed completed doctoral thesis with significant theoretical importance and practical application prospects, containing original results of the scientific research and providing new insights in the relevant field or sub-field of science; Competences appropriate to the level of international achievement in the relevant field of science, permitting to pursue an independent professional, scientific or academic activity. Competences: • To carry out independent, critical analysis, synthesis and evaluation, be able to solve significant research or innovation tasks in Engineering and interdisciplinary fields; • Be able to propose independently a research idea, to plan, structure and manage large-scale research projects in Engineering and interdisciplinary fields, including the international ones; • Be able to demonstrate knowledge and understanding of contemporary Engineering theories and scientific knowledge, and proficiency in modern research methods and methodologies appropriate to the sciences; • Be able to analyse the obtained results independently and draw appropriate conclusions from them; • Be able to plan research independently and to manage research or development tasks in organisations where extensive research knowledge and skills are required; • Be able to evaluate research material analytically and critically, to integrate theoretical knowledge into the research process, solve the problems, generate and develop new ideas; • Be able to improve independently the own scientific qualifications; • Be able to communicate independently in written form, demonstrating the comprehension of existing scientific knowledge and its application in practice, including the preparation and publication of internationally cited scientific articles and publications.*
Final examination upon the completion of the study programme	*At the end of the study programme, a doctoral thesis (dissertation) is defended*

Study programme forms

Full time studies - 3 years - latvian

Study type and form	*Full time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*120*
Admission requirements (in English)	*Master's degree in Information and Communication Technologies, Electronics and related areas. Entry examinations is an obligatory part for all applicants of the admissions process for Doctoral program.*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D) of Engineering and Technology*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 3 years - english

Study type and form	*Full time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*english*
Amount (CP)	*120*
Admission requirements (in English)	*Master's degree in Information and Communication Technologies, Electronics and related areas. Entry examinations is an obligatory part for all applicants of the admissions process for Doctoral program. For studies in English, it is necessary to present the results of English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D) of Engineering and Technology*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 4 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*120*
Admission requirements (in English)	*Master's degree in Information and Communication Technologies, Electronics and related areas. Entry examinations is an obligatory part for all applicants of the admissions process for Doctoral program.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D) of Engineering and Technology*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 4 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*120*
Admission requirements (in English)	*Master's degree in Information and Communication Technologies, Electronics and related areas. Entry examinations is an obligatory part for all applicants of the admissions process for Doctoral program. For studies in English, it is necessary to present the results of English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (Ph.D) of Engineering and Technology*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

By the decision of the Study Quality Commission No. 2020/18-I of 14 April 2020, the title of the degree to be obtained in the doctoral programme was changed in accordance with the classification of Latvian Republic of fields and sub-fields of science approved by the Cabinet of Ministers' Regulation No. 49 of 23 January 2018 "Regulations on Fields and Sub-Fields of Latvian Science". The scientific doctoral degree Doctor of Sciences (Ph.D.) in Civil and Transport Engineering shall be awarded after the development and defence of the dissertation in the sub-discipline of Telematics and Logistics.

On June 16, 2020, "Amendments to the Cabinet of Ministers' Regulation No. 1000 of 27 December 2005 "Regulations on the Delegation of the Right to Confer the Doctoral Degree (Doctoral Dissertation) to Universities" (Only in Latvian), the right to confer the doctoral degree (doctoral dissertation) in Civil and Transport Engineering was delegated to TTI.

The programme is licensed and accredited in three languages: Latvian, English and Russian. According to Article 49 of the Transitional Provisions of the Law on Higher Education Institutions, it is prohibited to enrol students for studies in Russian after January 1, 2019. The last students of all levels studied in Russian in TTI will graduate in June 2023. The programme is submitted for the next accreditation in two languages of instruction: Latvian and English.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The doctoral study programme "Telematics and Logistics" is implemented in accordance with the Law on the Higher Education Institutions, the Law on Scientific Activity, the Law on Education, the Cabinet of Ministers' Regulation No.1001 of 27 December 2005 "Procedure and Criteria for Awarding the Scientific Doctoral Degree (Promotion)", the Constitution of TTI, decisions of TTI Senate and the Regulations of the TTI Doctoral Studies (https://tsi.lv/wp-content/uploads/2022/10/regulations-for-doctoral-studies.pdf). The programme is implemented in compliance with the main directions of the TTI research; it is also aimed at preparation of a new generation of the academic staff and scientists in accordance with the

"Education Development Guidelines 2021-2027". The development of the doctoral programme is based on the European Qualifications Framework documents, the Bologna Process, the Salzburg Principles, etc.

The title of the study programme "Telematics and Logistics" corresponds to the degree of Doctor of Sciences (Ph.D.) in the field of Civil and Transport Engineering, sub-field of Telematics and Logistics, in accordance with the Regulation of the Cabinet of Ministers' No. 49 "Regulations on Latvian Scientific Fields and Sub-Fields".

As the title suggests, the programme is interdisciplinary, since Telematics is a branch of science that involves knowledge of computer sciences and communication technologies to develop the design, processes and techniques of services or applications that enable the transfer of data.

The concept of Telematics encompasses all areas of modern information, telecommunication and transport technologies (https://www.letonika.lv/groups/default.aspx?r=1107&q=nozare&id=2070707&g=1, Only in Latvian).

Telematics is an interdisciplinary field encompassing telecommunications, vehicular technologies (road transport, road safety, etc.), electrical engineering (sensors, instrumentation, wireless communications, etc.), and computer science (multimedia, Internet, etc.). Telematics can involve any of the following:

- The technology of sending, receiving, and storing information using telecommunication devices to control remote objects,
- The integrated use of telecommunications and informatics for application in vehicles and to control vehicles on the move,
- Global navigation satellite system technology integrated with computers and mobile communications technology in automotive navigation systems.

The programme admits students with a Master's degree in Information and Communication Technologies, Electronics or equivalent field.

The aim of the doctoral study programme is to prepare Doctors of Sciences, researchers and specialists of the highest qualification in the Telematics and Logistics sub-field, providing the theoretical and practical knowledge necessary for the independent scientific research work and pedagogical work

The objectives of the doctoral study programme are as follows:

- to learn the latest theoretical concepts and fundamental principles of methodology of research conducting and research methods in the chosen field of science;
- to conduct the scientific research on the chosen topic using the modern methods of analysis and data processing;
- to develop analytical, creative and critical thinking, the ability to solve problems in an innovative way;
- be able to present the research results at international scientific conferences and seminars, to prepare and publish scientific articles on the obtained research results;
- to develop skills in the area of leadership and change management, the ability to work in a team and cooperate with the professionals from different fields;
- to enhance the pedagogical skills by independent development of the study courses and delivering the academic lectures, supervising Bachelor, Master or Diploma theses.

The task performance measures are the results of the examinations of the study courses specified in the study plan, an independently developed doctoral thesis with substantial theoretical significance and potential for the practical application, which includes original results of the scientific research, obtained by independent evaluating and selecting the appropriate methods of modern research, providing new scientific knowledge in the field of environmental Engineering and technological sciences. In addition, students develop the competences appropriate to the level of international achievement in the relevant field of science, which are at the upper frontier of knowledge and allow addressing the critical problems in research and innovation, enabling undertaking the independent professional, scientific or academic activity, extending the existing knowledge and providing new insights into Engineering and technology topics.

As a result of completing the study programme, the graduate will (intended outcomes):

- perform the independent critical analysis, synthesis and evaluation, be able to solve significant research or innovation tasks in Engineering and interdisciplinary fields;
- be able to propose independently a research idea, plan, structure and manage large-scale scientific projects in Engineering and interdisciplinary fields, including the international ones;
- be able to demonstrate comprehension and understanding of the most up-to-date Engineering theories and scientific knowledge, and be proficient in modern research methods and methodologies appropriate to the sciences;
- be able to analyse the results independently and draw appropriate conclusions from them;
- be able to plan the research independently, to manage the research or development tasks in organisations where extensive research knowledge and skills are required;
- be able to evaluate analytically and critically the research material, integrate theoretical knowledge into the research process, reveal the problems, generate and develop new ideas;
- be able to improve independently the own scientific qualifications;
- be able to communicate independently in writing, demonstrating comprehension of the existing knowledge and its application in practice, including the preparation and publication of internationally cited scientific articles and publications.

The aims, objectives and planned learning outcomes of the study programme “Telematics and Logistics” are interconnected, and the possibility of achieving them is very high.

The programme complies with the main objective of the TTI Strategy and Development Programme 2021-2025: to ensure the implementation of the guiding principle of the National Development Plan 2021-2025 – to achieve an “economic breakthrough” in Latvia. TTI positions itself as one of the entities of Latvia that trains the specialists needed for the Latvian economy, as well as creates the new products and services, forming the basis for sustainable growth in Latvia. The Strategy of TTI includes the most important objectives of TTI development in the period up to 2025, as well as defines the activities to be carried out and the division of responsibilities for the implementation of the tasks to be carried out.

The purpose of a quality study process is internationally competitive, analytical and creativethinking specialists prepared in prestigious, internationally recognized high-quality studies, who ensure the development of the Latvian economy and who have the capacity to learn long-term. The aim of excellent research is high-quality scientific studies that meet the needs of Latvia and the international economy, are widely involved in international, national and sectoral research programs and are integrated into the study process. Sustainable valorisation aims at an efficient technology transfer and innovation development environment that promotes the creation of new technological companies and the creation of products.

The TTI Strategy 2021-2025 can be found at: https://tsi.lv/wp-content/uploads/2020/07/TSI-Strategy-2020-2025.pdf.

Admission to the Doctoral study programme takes place on a competitive basis in accordance with the TTI Admission Rules. The applicants are evaluated according to the following criteria: weighted average mark of the Master's Diploma Supplement; publications and their scientific quality; participation in the scientific research projects; participation in the scientific conferences; scientific and pedagogical work at TTI. The applicants take entrance examinations: in their speciality .

For studies in English, you must present a test score of at least B2 level from an internationally recognized testing institution, or take the TSI entrance exam in English, except for cases where the previous education was obtained in English

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The Doctoral Programme "Telematics and Logistics" has been developed in accordance with the development trends in the field and doctoral studies in Europe and the world, based on the recommendations of the World Bank researchers on doctoral level studies (https://www.izm.gov.lv/lv/pasaules-bankas-petijums), which emphasize that the aim of the doctoral studies is the development of young researchers and the promotion of innovation based on original research. The 2030 Agenda for Sustainable Development adopted by the UN General Assembly on 25 September 2015 sets out 17 key global development goals. They are aimed at the balanced development of the world economies. The implementation of the Doctoral Programme in Telematics and Logistics is related to the achievement of the following goals: high quality education (Goal 4), industrialisation, innovation and infrastructure (Goal 9) and sustainable cities and communities (Goal 11). *Telematics* is a branch of science that involves knowledge of computer science and communication technologies to develop the design, processes and techniques of services or applications that enable the transfer of data (https://en.wikipedia.org/wiki/Telematics).

The digital economy, and in particular its transport and logistics component, underpins the development of all spheres of national life; therefore, the demand for highly skilled professionals in intelligent transport systems and smart logistics is constantly growing. In 2019, the United Nations Conference on Trade and Development (UNCTAD) in its Technology and Logistics Division published a *Report on the digital economy*, which identifies one of its challenges as intensifying the training of professionals in *information and communication technologies* (ICT). The *Europe 2030 strategy* and the *EU's Ninth Framework Programme for Science and Technology for Development* set the goal of pan-European cooperation on national sustainable development in scientific, innovation and digitisation spheres. The Doctoral Programme in Telematics and Logistics, proposed by TTI, will not only train specialists in the digital economy, in particular in Intelligent Transport Systems and Smart Logistics, but will also promote the use of digital technologies for sustainable business development.

Latvia 2030 Sustainable Development Strategy, describing Goal 237, states: "The Internet and the digital environment not only enable access to services and information, but also offer opportunities for remote working and education, while reducing the need for and frequency of transport". This means that the use of the internet will allow people in Latvia to do some of their work from home and use less transport, while the digitalisation of the economy will change the relationships between the employee and the employer. Goal 448 of *Latvia 2030 Strategy* is related to e-government. "The introduction of e-government should be used to structurally reform the existing public administration, making it more efficient..." The creation of a new model of relations between both natural and legal persons will also create new forms of public administration, and the challenges related to its creation and functioning must also be addressed on the platform of the digitalisation of the economy.

The doctoral programme “Telematics and Logistics” can help to address a number of problems and issues that exist in the field of digitalisation of economy and business development, primarily in the transport and logistics sectors, and which are faced not only by Latvia, but also by the world as a whole.

All Doctoral students are employees of Latvian or international companies in Latvia or abroad, as well as researchers from universities and technology companies. They associate their doctoral studies with self-development and new perspectives in their scientific and academic careers.

Among the Doctoral students whose career development was directly linked to the graduation from the “Telematics and Logistics” programme and obtaining a Doctoral degree are:

- Evelīna Budiloviča – Riga City Council, the Head of Division – Deputy Head of Administration
- Andrejs Zvaigzne –Vice Rector of the Latvian Maritime Academy
- Irina Pticina –Vice-Rector of Transport and Telecommunication Institute (TTI)
- Ilyja Jackson – researcher at the Massachusetts Institute of Technology, Center for Transportation & Logistics (Cambridge, US)
- Aivars Muravjovs – the Head of the Management Department of IT Infrastructure of Riga Stradina University (RSU)
- Farid Saifutdinov – the Head of Air Navigation, Air Traffic Control, Kazakhstan
- Jörg Kundler – the Head of IT Services and Infrastructure Department at German Air Traffic Control
- Viktors Krebss – Oracle BI Senior Technical Consultant at Tieto Latvia

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

Statistical data on students are presented in Appendix No. 7.1.

The total number of students in the Doctoral programme is fairly stable, since the previous accreditation, the number of doctoral students in the programme is 15-20 students, but there is a tendency for them to take some time after completion of the programme before the thesis is defended and the Doctoral degree is awarded.

The doctoral study programme is licensed and accredited for full-time and part-time study in Latvian, Russian and English, but so far there has been little demand for studies in Latvian. Amendments to the Law on Higher Education of 21 June 2018 prohibited the admission of students to study programmes with Russian as a language of instruction. Therefore, in the academic year 2019/2020 students were no longer accepted for studies in Russian at TTI, and the academic year 2022/2023 is the last year when the study programme is still implemented in Russian. Students have been informed of this and if for any reason the programme is not completed, students will be offered the opportunity to continue their studies in Latvian or English.

The graphs in Appendix show a steady albeit slight upward trend in students numbers over the last 5 years. The programme occupies a rather specific interdisciplinary niche in the Latvian and international scientific space. In recent years, there has been an increase of interest in this field, which attracts the attention of the potential foreign students. Consequently, in the last reporting year, the programme had 14 (67%) foreign students.

Up to 20% of students from the entire programme are expelled each year, in the last reporting year they were 17%. Statistical data indicate that there are frequent cases where a person does not resume his/her studies after an academic leave. The main reasons given by the students for dropping out of their Doctoral studies are employment outside TTI and the inability to combine studies and the work on doctoral thesis with their job, as well as family circumstances (especially for women whose priorities change with the birth of children).

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The content of the study program and its implementation have been formed on the basis of the regulatory enactments and regulations of the Republic of Latvia, TSI internal laws and regulations, EUA’s (European University Association’s) proposed doctoral education principles, EQUAL guidelines for doctoral studies (EQUAL guidelines for doctoral programs in business and management, May 2016), respecting the strategic development and sustainable development objectives of the TSI and United Natio ns Sustainable Development Goals (SDG) in higher education.

The European University Association (EUA) has established a common understanding of the fundamental principles for doctoral education and PhD. The study program uses four key principles:

- The main part of doctoral education is the development of knowledge by carrying out original studies necessary for the economy and contributing to the development of higher education and research;
- All doctoral students are young researchers (Early Stage Reasechers) who, in cooperation with experienced researchers, make a significant contribution to the creation of new knowledge;
- Management of doctoral candidates and regular evaluation of achievements (including

development of competences) play a key role in doctoral education and the development of young scientists;
- The doctoral program offers cross-disciplinary, cross-sectoral and geographically wide research, ensuring cooperation with a wide range of partners in Europe and around the world, as well as student mobility.

As regards its structure and content, the study programme is targeted to attaining its goal which is closely related to the defined attainable study results of the study programme. Study courses are developed to ensure that they mutually and sequentially supplement each other and direct the study process towards full-scope acquisition of the study programme and attaining the envisaged results. The link between study courses and the study results of the study programme is reflected by the mapping of the attainable results of study courses (Appendix No. 7.2). A certain sequence is followed in planning implementation of study courses for successful attaining of the study programme results. The plan of the study programme is attached in Appendix No. 7.3. Descriptions of study courses attached in Appendix No. 7.4. The collection includes the descriptions of 6 compulsory study courses of the study programme (Part A), the descriptions of 10 elective study courses (Part B) and the descripton on doctoral thesis).

The study programme is designed to ensure the sequential development of knowledge, skills and competences, based on individual and group work, continuous communication between doctoral students and their supervisors.

First year of study (in total 40 CP):

- Compulsory study courses in the amount of 18 CP (Scientific and Legal Framework of the Doctoral Thesis, Research Methodology, Systems Theory, System Modelling, Multidimensional Statistical Analysis). There are both individual assignments and group assignments combined with role playing elements. The majority of the programme academic staff are involved in these courses (see course descriptions).
- Limited elective courses (4 CP), for example, Intelligent Data Processing, Operations Research, Artificial Intelligence, Big Data or other courses.
- Research activities - development of the doctoral thesis (18 CP) are carried out in collaboration with the thesis supervisor. At the end of the first year, at least one publication is prepared and submitted for publication, and a paper is prepared and presented at an international conference.

Second year of study (40 CP):

- Compulsory study courses (Research Methodology, Research and Pedagogical Organisation Practicum).
- Limited elective courses in the amount of 4 CP, for example, Intelligent Data Processing, Operations Research, Artificial Intelligence, Big Data or other courses.
- Free elective study courses – 4 CP, for example – Machine Learning and Predictive Analytics, Mathematics for Data Analytics, Information Systems and Technologies, Computer Vision and Image Processing or other courses
- The research work - development of the doctoral thesis (26 CP) is carried out in collaboration with the thesis supervisor. At the end of the second year at least two publications and presentations at international conferences must have been prepared and published. The dissertation is ready for 40...50% at this stage.

The third year is devoted to the scientific work, research, publication of the obtained research results, participation in the exchange and mobility projects. The individual work of the Doctoral student is intensified, cooperation with the supervisor is ensured as well as regular opportunities to meet other Doctoral students for experience and knowledge transfer. The work on the scientific publications continues (at least 2 publications have to be prepared and submitted for publication), and the international cooperation of the young scientists is developed. In the third year, the final phase of the research is ensured, preparation for submission to the Promotional Council. The work in the field of scientific publications continues (at least 2 publications have to be developed and submitted for publication) and the international cooperation of the young scientist is established. During the third year of studies, the pre-defence of the doctoral thesis also takes place: the members of the TTI Promotion Council, the supervisor of the doctoral thesis, doctoral students and other interested parties participate in it. It is decided during the pre-defence whether the thesis should be submitted or whether any improvements to the thesis should be made.

It should be noted that not all Doctoral students can cope with the study plan. Some doctoral students choose to go on an academic leave after their second or third year of study, during which they work individually to strengthen their knowledge in a specific research area.

In part-time studies, the duration of the programme is 4 study years, with the distribution of study courses per study year less than 40 CP, that is, 32 CP in the first, second and third year of study, 24 CP in the fourth year of study. In accordance with the distribution of credit points per semester, similar to full-time studies, compulsory and limited optional study courses are taken and scientific activity is carried out, with the first two years of study reserved for compulsory theoretical courses, and the last 8th semester reserved only for scientific work.

The information contained in the study courses forms a logical interconnection, ensuring the upward development of students' knowledge and skills. In the first year of study, a general foundation for conducting the individual research in the chosen field is established; this basis is further developed and strengthened in each subsequent year of study, creating young scientists capable of independent, critical analysis, synthesis and evaluation, and of solving important research or innovation tasks in Engineering and interdisciplinary fields.

The content of study courses is regularly updated according to the development trends of the industry, labour market and science. The continuous relevance of the study programme is ensured to a large extent by the vision of the programme faculty - professionals and experts in the field - of the development trends in Electronics, Automation, Robotics and the ICT in their respective course topics. This is significantly facilitated by the active practical, scientific and research activities of the programme lecturers - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities.

Study courses, including the contents of the course descriptions, are reviewed annually during the study programme and study direction self-assessment procedure, held in December and January in accordance with the course management regulations. As a result of such self-assessment, a programme development plan is drawn up, which comprises various aspects of the study course including updating of course descriptions following the specific field, labour market and science development trends. There taken into account the feedback from the students in the study course evaluation questionnaires and the opinion of graduates and employers, providing input on the latest developments and current trends in the labour market. The updated courses are coordinated, approved and included in the study programme register and published in the e-learning environment Moodle by the beginning of the new academic year.

3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study

programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

The relevance of the programme to the needs of the labour market and the employment of scientists in the research institutes, as well as correspondence to the scientific trends is demonstrated by the high and steadily increasing demand for Doctoral Degree holders in all fields of Engineering.

When admitting the Doctoral students, the thesis supervisors ensure that the topics are in line with the EU research interests, research projects carried out by TTI, as evidenced by the participation of many Doctoral students in various international projects (for example, Horizon 2020, COST, Erasmus+, etc.).

The Doctoral students of the TTI study programme "Telematics and Logistics" are the leaders in the impact of scientific results on the development of engineering and ITC industry in Latvia: the findings of their doctoral theses are used in the development of the national and the EU policy documents, strategies, planning documents, integrated into the content of study courses; moreover, some of the research initiated during the Doctoral studies are continued in scientific projects and implemented in industries. All faculty members and Doctoral students involved in the programme participate in the international or local scientific or research projects.

The study courses included in the Doctoral programme, comprise the issues related to the implementation of the National Research and Innovation Strategy for the Transformation of the Economy "Smart Specialisation Strategy" (RIS3) in the research.

The Doctoral students of the study programme actively participate in the creating feedback process with industry experts and the public by taking part in various publicity events, such as roundtables, industry seminars, TV programmes and radio interviews.

The Doctoral degree (Ph.D.) in "Engineering and Technology" in the branch group "Civil and Transport Engineering" is awarded to the graduates of the programme if they have defended a Doctoral thesis developed in the branch "Telematics and Logistics" (Regulations of the Cabinet of Ministers No. 49 of 23.01.2018 "Regulations on Latvian fields and subfields of science", p. 2.1), which is the original completed research of significant importance in the field. The impact of the results on the engineering sector is evidenced by the fact that the candidates for the Doctoral Degree have:

- at least four (corrected to 4 in the next paragraph) anonymously peer-reviewed scientific publications in a journal indexed in the SCOPUS database with a Source Normalized Impact per Paper (SNIP) per publication or indexed in the Web of Science database with a defined Impact Factor (IP) per publication;
- at least one anonymously reviewed scientific publication in an edition indexed in the SCOPUS database, with a stated source impact indicator (Source Normalized Impact per Paper (SNIP)) on a publication or indexed in a database on the Web of Science for which an impact factor indicator is defined (Impact Factor (IP));
- anonymously reviewed scientific publications in scientific journals or conference reporting publications indexed in the database SCOPUS or Web of Science;
- a study carried out in one of the research projects;
- reports at international scientific conferences or seminars;
- modern data analysis and processing methods used in the study.

The graduates of the TTI doctoral study programme "Telematics and Logistics" usually significantly exceed the above described criteria. For example, compiling data from the SciVal tool on the graduates of the 2020-2021 academic year of the doctoral study programme "Telematics and Logistics", it can be concluded that 12 graduates in total in the period 2015-2022 produced 66 publications that have been indexed in SCOPUS databases (a list of graduates and their thesis topics can be found in Section 2.5 of the programme profile).

At all stages of their studies, the Doctoral students are involved in the learning process, thus ensuring the transfer of knowledge, experience and research results at different levels of the study. The results of the research carried out during the doctoral studies are integrated into the Master and Bachelor Degrees programmes in the relevant scientific fields, which ensures the integrity of knowledge transfer and research at all levels of the study.

The Doctoral programme covers the main research areas of the Faculty of Engineering (FE) (https://tsi.lv/research/phd/phd-topics/): Modeling and analysis of data flows from smart logistic objects in transport systems, Simulation and machine learning of ground traffic control system in airports, Big data-driven based approach to flight delay prediction, Prescriptive analytics in aircraft maintenance: modelling and process optimization, Research of new overbooking methods based on artificial intelligence, Passenger flow simulation based on agent-based approach with AI elements, Development of maintenance process smart models for the purpose of digitization, Intelligent algorithms and intelligent systems for the object control, Development of a digital ecosystem of the processes of operation and maintenance of aircraft using artificial intelligence applications, Machine learning in aviation industry (data driven approach), Methods and algorithms of sensor systems for intelligent control and monitoring in transport networks, Methods and algorithms for image processing of moving objects in the problem of automatic control, identification and tracking of the objects for passenger transport nodes and so on.

The vision of the Faculty of Engineering is to be recognised as a centre of excellence for international research and studies with local and global impact in the fields of management engineering, safety, technology and innovation transfer, based on our researchers, graduates, research and strategic partnerships.

The Doctoral programme is designed to cover all the main research areas of the Faculty of Engineering. The faculty has defined four key strategic areas on which the long-term research goals of the faculty are based, which can only be implemented through the active involvement of the students or the graduates in the Doctoral programme "Telematics and Logistics":

- To increase the number of high quality and internationally recognised researchers;
- To ensure an internationally recognised research process, taking into account the increasing number of publications, research projects, conferences, etc.;
- To ensure an efficient research infrastructure by investing in the development of high quality research infrastructures and providing comprehensive research resources;
- To ensure sustainable innovation, commercialisation and technology transfer by fostering interdisciplinary knowledge and technology creation through the establishment and maintenance of international research partnerships;
- To improve internal and external communication and cooperation.

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to

the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The methods used in the study program contribute to the achievement of study courses and program objectives and results, taking into account the student-centered teaching and learning principles. Compliance with the principles of student-centred education (hereinafter – SCL) is constantly ensured. According to the SCL manual defined, the participation of students in the study process and in the development of content is ensured, which gives students both additional duties and powers. Students have the opportunity to influence their studies, exercise their autonomy, provide feedback on the study process by matching their expectations. The TSI student selfgovernment, which actively participates in all these processes and carries out the annual evaluation of teaching staff, plays an important role in ensuring a link between students, teaching staff and the program administration. In several documents, the Code of Ethics, the Plagiarism Control Rule, the Study Procedure Rules, the methodological instructions for the development of studies and final theses, etc. – define the teaching and learning guidelines.

The study program and the study courses included therein are student-centred, because it takes into account and respects the different contingent of students, their past knowledge, skills and experience, the diversity of doctoral needs, thus applying individual learning pathways to each. The implementation of the study program includes a variety of ways of implementing the content of the study course. Teaching staff works with students in small groups or individually, allowing them to use pedagogical and andragogenic teaching methods that are relevant to the circumstances. The study process has been organised in such a way as to promote the independence of doctoral candidates, while ensuring the leadership and support of the teaching staff as scientific manager and mentor. The study process organised in this way contributes to mutual respect and contributes to the growth of all parties involved in the study process. At the same time, objective consideration of initiatives and objections shall be ensured.

Assessment of learning outcomes shall be carried out in accordance with the Doctoral Study Regulations (https://tsi.lv/wp-content/uploads/2022/10/regulations-for-doctoral-studies.pdf).

The assessment of studies, in line with the decisions of the TTI Senate, uses a summary achievement assessment approach. At the beginning of the study course, doctoral candidates shall be presented with the criteria and methods for evaluating the course of the studies concerned. The specific evaluation criteria for each study course should be presented to students in the first lesson and published in the course's e-study environment on the TTI intranet.

The evaluation results are designed to give students an insight into the extent to which they have achieved the results of their studies. Teaching methods, structure of study courses and evaluation methods shall be selected by the teaching staff responsible for the study course, in accordance with the specific nature of the content and program of the course, as well as the needs of students. Training courses and seminars on the latest teaching, pedagogical methods are organised for academic staff, as well as the promoting the attendance of refresher courses, both at internal faculty events and at TSI level, and internationally

The students receive feedback, which usually provides advice on the learning process and on ways to improve their research skills. All courses are assessed by a committee of at least three examiners (experts with a Doctoral Degree in the field), called the Examination Board within the Doctoral Study Programme. The composition of the Course Board is reviewed and renewed at the beginning of each academic year. The composition of the Board shall take into account the current developments in the field, the achievements of the academic staff during the academic year, and feedback from the students. The members of the Examination Board shall be familiar with the methods of testing and examination and shall be supported in developing their skills in their area of competence. Assessment is consistent, applied uniformly to all students and is carried out in accordance with the procedures approved by TTI.

Students receive feedback, which typically provides advice on learning processes and research skills development. In all courses, the evaluation shall be carried out by at least three examiners (experts with PhD in the field concerned), known as the examination commission within the program. At the beginning of each academic year, the composition of the subject commission shall be reviewed and renewed. The composition of the commission shall take into account the developments of the sector, the achievements of the teaching staff during the relevant year of study, the feedback of students. The members of the examination commission shall be familiar with the testing and examination methods and shall receive support for the development of their skills in their area of competence. The evaluation is consistent, uniformly applied to all students and is implemented in accordance with procedures approved by the TTI.

The achievement of study courses and program objectives and results within the framework of the program shall be carried out at regular intervals by organising teaching staff seminars and discussions on the results of studies and the basic principles for quality assurance. The study program shall ensure the full implementation of the results of studies. The results of studies are formulated at the level of both study program and study courses. Students shall be informed of the results of the studies to be achieved at the beginning of each study course, as well as shall be available in the Moodle environment. As mentioned above, there is a link between the results achieved by the study program and study courses.

The interconnection of the study courses and the sequence in learning the study content is evaluated once a year during the annual self-evaluation. According to the results achieved by the study programme, the content and extent of study courses in credit points are created, while topics and their extent in hours are created according to the results achieved by the study course. The results to be achieved in all study courses shall be verified by appropriate evaluation methods.

Independent studies of doctoral students play an important role. A description of their procedure is included in the description of the study course as a mandatory component. The skills of students to study independently shall be developed purposefully in all study courses and in the framework of scientific work. Students acquire research skills by working regularly with literature and Internet resources, conducting scientific studies, preparing publications, reporting at conferences, etc.

The Doctoral study programme is implemented in close collaboration with the supervisor of the thesis. In addition, reporting to TTI is done every semester at meetings of the Faculty of Engineering (at least once a semester for the students of other courses). This type of study programme implementation mechanism allows ensuring the achievement of the study results.

The methods used to provide the study programme do not affect the languages of study, especially because the doctoral programme is currently (as of January 2023) practically provided only in English, there is one student in Russian. There is currently no demand for studies in Latvian.

The impact of the mobility programmes and opportunities for intercultural communication are increasingly entering the daily lives of the doctoral students. Students arriving at TTI as part of mobility are supported at the level of the Student Council, the study programme and the faculty management. For example, particularly good cooperation has been established for the Doctoral students with the University of Thessaly (Greece), Fraunhofer Institute for Factory Operation and Automation (Germany), Delft University of Technology (Netherlands), Umeå University (Sweden), University of Edinburgh (UK), University of Copenhagen (Denmark), Häme University of Applied Sciences (Finland), The Swedish National Road and Transport Research Institute (VTI), University of Ioannina (Greece), University of Murcia (Spain), Aalen University (Germany), University of Lodz (Poland), University of the West of England (UK) etc..

Doctoral students of the “Telematics and Logistics” programme did not make full use of mobility opportunities. This is most often due to the fact that the doctoral students are employed at the start of their doctoral studies and cannot afford to go on short or long-term mobility, as well as family circumstances prevent a large number of doctoral students from taking advantage of mobility trips.

To enable Doctoral students to carry out not only theoretical but also practical scientific research, the well-equipped laboratories of TTI allow students to carry out the high-quality measurements and to operate the latest generation of technological equipment. The Doctoral students have access to a wide range of scientific and research infrastructure. Students have access to extensive real time databases, research and analysis tools. Many resources are also available to students outside the classroom: the TTI Research Library, Web of Science, Scopus, Direct Science and other online scientific databases and libraries.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

Not relvant

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

Cabinet of Ministers’ Regulation No. 1000 of 27 December 2005 “Regulations on the Delegation of the Right to Award the Doctoral Degree (Doctoral Dissertation) to Higher Education Institutions” delegated the right to award (promote) the Doctoral Degree in Civil and Transport Engineering to the Institute of Transport and Telecommunications.

The Promotion Council of TTI was established by the Rector’s Order, in accordance with the Cabinet of Ministers’ Regulation No. 1001 of 27.12.2005 “Procedures and Criteria for the Award of the Degree of Doctor of Science”. All members of the Promotion Council hold a Doctoral degree in a relevant field or sub-field and are experts of the Latvian Council of Sciences.

Members of the Promotion Council are as follows: Dr.habil.sc.ing. Igors Kabaškins, Dr.sc.ing. Irina Jackiva, Dr.sc.ing. Boriss Mišņevs, Dr.sc.ing. Dmitry Pavlyuk, Dr.sc.ing. Mihails Savrasovs, Dr.sc.ing. Aleksandrs Grakovskis, Dr.habil.sc.ing. Jurijs Tolujevs, Dr. Olegas Prentkovskis. Olegas Prentkovskis is a Professor at Vilnius Gediminas Technical University, serving as a permanent member of the Promotion Council since 2021.

The Promotional Council operates and evaluates the Doctoral thesis in accordance with the *TTI Regulations on the procedure and criteria for awarding (the promotion) of a scientific doctoral degree (https://tsi.lv/wp-content/uploads/2022/10/nolikums-par-doktora-grada-pieskirsanu-ver2_eng.pdf).*

When accepting a thesis for defence, the Council shall appoint three reviewers for the thesis, one of whom shall be an expert of this Council in the relevant subfield of science, and two of whom shall be the experts from other scientific institutions or organisations, one of whom shall be a foreign scientist.

During the reporting period, the academic staff of such universities were engaged as foreign reviewers: Eftihia Nathanail (University of Thessaly, Greece), Slavomir Augustyn (National Defence University, Poland), ILia B. Frenkel (Chair Sami Shamoon College of Engineering, Israel), Dr.-Ing. Richter Klaus (Institute of Logistics and Material Handling Systems (ILM) of the Otto-von-Guericke-University Magdeburg), Jonas Stankunas, Ramūnas Palšaitis, Andrius Jeržemskis (Vilnius Gediminas Technical University, Lietuva), Chatys Rafal (Kielce of Technical University Department of Mechatronics and Machinery Design, Poland), Juraj Vaculík (University of Žilina, Slovakia), Jaroslaw Sugier (Wroclaw University of Technology, Poland), Sergei Molokov – Coventry University (UK), Vytautas Paulauskas (University of Klaipeda, Lithuania), etc. The list of reviewers is continuously updated through cooperation in the scientific projects, development of the scientific publications, participation in the international conferences, etc.

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The thesis topics (fields of research) are selected when students apply for admission to the programme. At the same time, the programme director recommends a potential supervisor and advisors. At the commencement of doctoral studies, each doctoral student is assigned a thesis supervisor by the Rector of TTI. The topic of the doctoral thesis is specified before the thesis is defended.

The Doctoral theses defended within the "Telematics and Logistics" programme are internationally oriented, including the case study examples on Latvia.

The research topics (https://tsi.lv/research/research-at-tsi/research-directions/) are as follows: Smart Cyber-Physical Systems, Internet of Things and Connected Smart Object Platforms, Robotics, Cyber Security, Big Data, Virtual Reality Applications, Smart Solutions in Transport and Logistics, Intelligent Transport Systems, Transport Simulation and Modelling, Smart Logistics, Smart Cities and Urban Mobility, etc.; they are the relevant ICT topics in the European Union.

The study programme is oriented towards addressing these issues, enabling the achievement of the programme objective and, following the research in the telematics and logistics sub-field, the award of a Doctor of Science (PhD) degree in Civil and Transport Engineering.

The evaluation of the doctoral thesis in accordance with the Cabinet of Ministers' Regulation No. 1001 of 27.12.2005 "Procedures and Criteria for the Award (Promotion) of the Degree of Doctor of Science", carried out by the Promotion Council, the review by three reviewers and the public defence of the doctoral thesis ensure the correlation between the results of the doctoral study programme and their achievability.

Theses defended in the doctoral programme "Telematics and Logistics" during the reporting period:

3 doctoral theses were defended in 2013:

- Staņislavs Arie Fradkins: thesis topic "Modelling of the urban transport impact on the city atmospheric environment using apparatus of mathematical physics".
- Mihails Savrasovs: thesis topic "Development of new approach for simulation and analysis of traffic flows on mesoscopic level ".
- Jelena Jurševiča (Kijonoka): thesis topic "Methodology of decision-making support based on urban transportation system microscopic models repositories"

3 doctoral theses were defended in 2014:

- Aleksandrs Kraiņukovs: thesis topic "Reconstruction of the Roadway Coverage Parameters by Radar Subsurface Probing"
- Sergey Yunusov: thesis topic "Improvement of Models and Methods for Diagnostics of Gas Path of Gas Turbine Engine in the Aircraft Power Plant Monitoring Systems".
- Joerg Kundler: thesis topic "The methodology of maintenance and technical service model development for air traffic control service providers".

6 doctoral theses were defended in 2015:

- Nadežda Spiridovska: thesis topic "Nontraditional regression models in transport planning and modeling".
- Viktors Krebss: thesis topic "Research on localization methods of transportation networks objects using spatial databases".
- Dmitry Pavlyuk: thesis topic "Study of European airports' efficiency on the basis of spatial stochastic frontier analysis".
- Irina Pticina: thesis topic "Integral estimation of urban public transport system service quality from the end-users point of view".
- Aivars Muravjovs: thesis topic "Inventory control system analysis using different simulation modelling paradigms".
- Sergejs Kamenčenko: thesis topic "Increasing the level of information security of intelligent transport systems by making modernization of cryptographic methods used in information protection over data transmission channels".

2 doctoral theses were defended in 2017:

- Marina Rebezova: thesis topic "Logistics and optimization of ancillary aviation services on air transport".
- Andrejs Zvaigzne: thesis topic "Decision making at the early stages of the design of a multifunctional special purpose ship with modularly oriented architecture".

2 doctoral theses were defended in 2019:

- Iyad Alomar: thesis topic "An investigation of alternative methods for controlling the movement of ground vehicles in airports".
- Evelīna Budilovičа: thesis topic "Decision Support Framework for the Urban Transport Interchange Transformation Based on the Principles of Sustainable Mobility. Case Study of

Riga City".

1 doctoral thesis was defended in 2020:

- Ilya Jackson: thesis topic "Neuroevolutionary approach to metamodeling and optimization of inventory control systems".

1 doctoral thesis was defended in the first semester of 2022:

- Farid Saifutdinov: thesis topic "Development and testing of the Digital Twin concept as a process data store in ground traffic control systems at airports".

Since 100% of the programme graduates go on to work in higher education institutions or provide guest lectures, the results of the research carried out in the theses are also incorporated into the study process, ensuring knowledge transfer and further use. On the other hand, the majority (around 90%) of the insights and know-how generated by the Doctoral students in their theses are integrated into the project applications and further developed in the Faculty of Engineering at TTI. Below there are some examples of the integration of the results of the study process (Doctoral theses) into science:

- Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer (ePIcenter). Period: 01.06.2020- 31.12.2023. Programme: HORIZON 2020 – Dmitry Pavlyuk;
- Workforce Europe – Transformation agenda for transport automation (We-Transform). Period: 01.12.2020- 30.11.2023. Programme: HORIZON 2020 - Dmitry Pavlyuk;
- Fundamentals of Design Competence for Our Digital Future. Period: 01.01.2021- 31.12.2024;
- Programme: H2020-MSCA-ITN-2020 (Marie Skłodowska-Curie Innovative Training Networks) - Dmitry Pavlyuk, Nadežda Spiridovska;
- Ecosystem for European Education Mobility as a Service: Model with Portal Demo. Period: 01.11.2021- 31.10.2023. Programme: ERASMUS+ - Evelīna Budiloviča;
- Intelligent Transport and Transport Management (INTELTRANS). Period: 01.04.2020. - 30.09.2022. Programme: ERASMUS+ - Viktors Krebss, Evelīna Budiloviča;
- Spread your wings. Period: 01.12.2017- 31.08.2020. Programme: ERASMUS+ - Iyad Alomar, Farid Saifutdinov;
- Smart Logistics and Freight Villages Initiative (SmartLog). Period: 01.09.2016- 31.05.2020. Programme: INTERREG Central Baltic - Sergejs Kamenčenko;
- Enhancing excellence and innovation capacity in sustainable transport interchanges (ALLIANCE). Period: 01.01.2016- 31.12.2018. Programme: HORIZON 2020 - Dmitry Pavlyuk, Nadežda Spiridovska, Irina Pticina, Evelīna Budiloviča;
- COST Action TU1408 Air Transport and Regional Development (ATARD). Period: 25.03.201524.03.2019. Programme: COST Action - Dmitry Pavlyuk;
- Harmonised and Modernised Multidisciplinary Railway Education (EDU-RAIL). Period: 01.10.2015- 30.09.2018. Programme: INTERREG Central Baltic - Ilya Jackson.

After defending their doctoral thesis, many young scientists continue active independent scientific activity as doctors of science, receiving grants and implementing post-doctoral research projects. For instance:

- Postdoc: Dr.sc.ing. Nadežda Spiridovska. Project "Nontraditional regression models in transport modelling" (1.1.1.2/VIAA/1/16/075). Period: 01.10.2017- 30.09.2020. (https://tsi.lv/projects/project-nontraditional-regression-models-in-transport-modelling-1-1-1-2-viaa-1-16-075/)
- Postdoc: Dr.sc.ing. Dmitry Pavlyuk. Project "Spatiotemporal urban traffic modelling using big data" (1.1.1.2/VIAA/1/16/112). Period: 01.10.2017- 30.09.2020. (https://tsi.lv/projects/project-spatiotemporal-urban-traffic-modelling-using-big-data-1-1-1-2-vi

aa-1-16-112/)

- Postdoc: Dr.sc.ing. Tatiana Endrjukaite. Project „Integrated Model for Energy Generation, Distribution and Management” (1.1.1.2/VIAA/1/16/095). Period: 01.12.2017- 30.11.2020. (https://tsi.lv/projects/project-integrated-model-for-energy-generation-distribution-and-management-1-1-1-2-viaa-1-16-095/)
- Postdoc: Dr.oec. Jeļena Popova. Project “Model of Smart Economy in a Smart City” (1.1.1.2/VIAA/3/19/458). Period: 01.06.2020- 31.05.2023. (https://tsi.lv/projects/project-model-of-smart-economy-in-a-smart-city-1-1-1-2-viaa-3-19-458/)

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

The detailed information on these issues is provided in the Study Programme Report, Part II, Chapter 3, Sections 3.2 - 3.4.

Research infrastructure of TSI is under direct supervision by Vice-Rector for research and development and faculties of TSI. The core of research infrastructure is concentrated in TSI Telecommunications, electronics and robotics Center (TERC) (https://tsi.lv/research/research-at-tsi/research-support-structure/terc-telecommunications-electronics-and-robotics-center/) , which unites 11 labs: Laboratory of Industrial Robots, Laboratory of mobile robots, Laboratory of Physics and Electrical Machines, Laboratory of Modelling of Electronic Systems, Laboratory of Embedded Systems and Digital Signal Processing, Laboratory of Industrial Automation, Laboratory of Subsurface Radiolocation, Laboratory of Robotics and Students’ Research Work, Laboratory of Designing and Prototyping, Laboratory of Telecommunications and Electro-Optical Systems, Laboratory of Electronics. All listed labs are equipped by the modern devices and software, which supports academic and research process. More than 1000 units of equipment and software is available for researches, students and academic staff.

In addition to TERC’s labs TSI is operating:

- Laboratory of Applied Software Systems (LAS) (https://tsi.lv/research/research-at-tsi/research-support-structure/simlab-laboratory-of-applied-modelling/) which is supporting research in the area of modern IT application. Laboratory has more than 100 licenses of the software tools, including unique software for traffic flow, business-processes, logistic-process simulation (as example PTV VISSIM, VISUM etc.) and provides the consulting services to the local private and public sector. For the last 6 years LAS staff has completed more than 15 projects.
- Image Processing, Biometry & Automated Border Control Systems (IPB & ABC) (https://tsi.lv/research/research-at-tsi/research-support-structure/ipb-abc-lab-image-processin

g-biometry-automated-border-control-systems-laboratory/) lab was developed in cooperation with local business entity “XInfoThech” Ltd. laboratory provides the research related with image processing, biometry etc, also team of lab organizes the competition of research works among TSI students in annual bases.
- Laboratory for Modelling Machinery Mechanisms and Materials (4M) (https://tsi.lv/research/research-at-tsi/research-support-structure/laboratory-of-modeling-machinery-mechanisms-and-materials-4m/) conducts theoretical and practical research in the field of transport and mechanical engineering. The main activities are related to structural, computational and strength, reliability-diagnostic and hydro-gas dynamic modelling.

TSI supports “open-access” policy and provides share of its equipment and software. TSI is a part of the UseScience project which is targeted on equipment’s sharing among research and academic entities.

As a member of association European Conference of Transport Research Institutes (ECTRI), TSI resources are included into global transport research sharing Database "Soft Research Infrastructures" and TSI researchers could use the resources more ECTRI members (27 EU research Institutes) https://www.ectri.org/about-ectri/members/. In addition, TSI students academic and research staff has access to electronic library of TSI, which provides journals, conference proceedings, books and text books in electronic form. Library provides possibility to use international electronic databases: “Knovel”; EBSCO, “Academic Complete”; OAPEN-Library; DOAJ; PKP; WorldBank; VersitaOpen etc.

All research activities of TSI are administrated, supported, recorded and documented by the staff of R&D department and aggregated in internal database. Additionally, R&D department is responsible for information provision for sciencelatvia.lv (national science system).

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

In the course of implementation of the doctoral programme the doctoral students make use of the scientific base and resources of foreign partner organisations with which TTI has signed the agreements providing for such an opportunity, in addition to TTI own scientific base. The partners of TTI in the mobility of doctoral students are as follows:

- Otto-von-Guericke University of Magdeburg (Germany)
- The University of Thessaly (Greece)
- University of Deusto (Spain)
- Tallinn University of Technology (Estonia)
- Vilnius Gediminas Technical University (VGTU) (Lithuania)
- Keio University (Japan)
- University of Murcia (Spain)
- Kaunas Technological University (Lithuania)
- University of Economy in Bydgoszcz (Poland)
- Wroclaw University of Technology (Poland)
- Kyiv National Economic University named after Vadym Hetman (Ukraine)
- University of Economics and Innovation (WSEI-Lublin) (Poland)
- Margad University of Mongolia (Mongolia)

- Fraunhofer Institut für Fabrikbetrieb und-automatisierung IFF (Germany)
- Transport Research Centre Polytechnic University of Madrid (UPM) (Spain)
- DeustoTech, Bilbao (Spain)
- Transport Research Centre (CDV) (Czech Republic)
- The Centre for Research & Technology, Hellas (Greece)
- National Centre of Space Research and Technology (Kazakhstan)
- ESC-AEROSPACE (Czechia)
- National Company Kazkosmos (Kazakhstan)

The following examples of the use of the scientific base and resources of foreign partner organizations can be given:

- The Otto-Von-Guericke University of Magdeburg (Germany) has a virtual reality center where doctoral students have the opportunity to conduct experimental research on their research topics. For example, Evelīna Budilovića, while developing measures to improve the efficiency of the transport system of the city of Riga, participated in the modeling of the city's transport infrastructure, using elements of the city's transport infrastructure virtual reality.
- At the University of Thessaly (Greece), a group of TSI PhD students underwent training and conducted experimental research on modeling transport systems within the summer school "Sustainable Urban Mobility" specially organized for them. For example, Iyad Alomar took advantage of the opportunity to use simulation software packages in his doctoral thesis to develop automated systems for specialized transport traffic at airports.
- Conducting research on the use of artificial intelligence in logistics, PhD student Ilya Jackson did an internship at the Tallinn University of Technology (Estonia) and Fraunhofer Institut für Fabrikbetrieb und-automatisierung IFF (Germany).
- Doctoral student Farid Saifutdinov, while developing air traffic control digital twin systems, conducted experimental research at the National Company Kazkosmos (Kazakhstan).
- and others.

Extensive opportunities for doctoral students to use the research base are also available at other Latvian universities and research organisations. TTI has agreements with the following organisations in order to implement this opportunity:

- Riga Technical University (RTU)
- University of Latvia (LU)
- Latvia University of Agriculture (LLU)
- Latvian Maritime Academy (LJA)
- Rezekne Academy of Technologies (RezA)
- Vidzeme University of Applied Sciences (VA)
- Ventspils University College (VentA)
- Riga International School of Economics and Business Administration (RISEBA)
- Institute of Electronics and Computer Science (EDI)
- Institute of Physical Energetics (FEI)
- Accenture Latvia
- Deloitte Latvia
- SAF Tehnika
- Riga International Coach Terminal
- International Airport Riga (RIX)

When carrying out the promotional research, the doctoral students have the opportunity to use data and resources of Latvian state and municipal organisations:

- Latvian Ministry of Transport

- State Education Development Agency
- Central finance and contracting agency
- Latvian Investment and Development Agency
- The Baltic-German University Liaison Office
- Riga City Municipality
- Bauska City Municipality
- Jelgava City Municipality

Such cooperation with leading foreign universities and research institutes (cooperation partners in Appendix No. 15 of the study direction) allows to provide both a unique experimental base and scientific and methodological expertise, to create joint publications within the framework of cooperation. Several doctoral students have developed parts of their research work in foreign and Latvian universities and research institutes.

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the programme was founded, the tuition fee income has been the main source of funding for the study process. The programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee per full-time student is EUR 4 000 per year, for part-time students is EUR 3 000 per year. The amount of tuition fee for each academic year is determined and approved by the Rector’s Order. The tuition fee payment procedure is set out in the Regulations on Tuition Fee Payment Procedure, which provides for the possibility of paying tuition fees for the entire study programme, for one academic year, for one academic semester or on a monthly basis (starting from the 2nd semester).

Average costs are presented in Appendix 7.9. The cost structure of the study programme in the last academic year 2021/2022 includes salaries and taxes (including scientific publications, etc.; including fees for academic staff in accordance with the TTI Academic Staff Remuneration Regulations) amounting to 51%, study programme development and implementation costs amounting to 7%, teaching materials and other similar costs amounting to 13%, scientific infrastructure costs and other similar costs amounting to 19%, advertising and marketing costs amounting to 2% , infrastructure costs (including IT costs) amounting to 6%, depreciation and amortisation 1%, other administrative costs 1% .

The Doctoral Study Department announces the call for applications at the beginning of each calendar year. The grant funding is allocated each year according to the decision of the TTI Council. The grant is awarded to full-time Doctoral students for one academic year with an automatic renewal option for the full academic period (3 years) based on the results of the Doctoral student’s positive annual attestation.

In support of Ukrainian citizens, the Doctoral programme offers 3 special grants for potential

Doctoral students with Ukrainian citizenship in the academic year 2022/2023 (https://tsi.lv/future-students/loyalty-grants/discounts-and-grants-from-tsi/tsi-grants-for-doctoral-students/)

The Doctoral programme in “Telematics and Logistics” is unique for Latvia and for the Baltic States. Digitisation processes are among the priority objectives of Latvia’s National Development Plan 2021-2027 (NDP2027). The implementation of this goal requires addressing the challenge of training specialists in the field of Telematics and Logistics and sustainable business development based on modern smart digital technologies; nevertheless, in Latvia – as in the other Baltic States – there is no doctoral study programme in this field available, and this is what determines the need for a doctoral study programme “Telematics and Logistics”.

Under these circumstances, it is still appropriate to train even only a few highly qualified specialists in this field of science.

From a financial point of view, the tuition fee set for each doctoral student is sufficient to cover the full cycle of his/her doctoral studies. The costs of defending the doctoral thesis are covered by the separate funds earmarked for this purpose in the budget of the Doctoral Council.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The implementation of the study programme is ensured by 7 people of academic staff with an appropriate academic experience and qualifications, 6 of whom are elected professors in the basic position: Dr.h.sc.ing. Igors Kabaskins, Dr.sc.ing. Irina Jackiva, Dr.sc.ing. Aleksandrs Grakovskis, Dr.sc.ing. Dmitry Pavlyuk, Dr.sc.ing. Irina Pticina, Dr.sc.ing. Mihails Savrasovs; and 1 Emeritus profesors Dr.hab.sc.ing. Jurijs Toluevs.

The high level of qualification of the faculty members involved in the study programme is evidenced by their scientific research activities, publications indexed in the scientific databases (list of publications is attached in Appendix 7.11), involvement in the research projects (see Section 4.4)

Brief summaries of the qualifications of the faculty members involved in the Doctoral programme are given below, as well as on the TTI website (https://tsi.lv/about-us/academic-staff/):

Professor, Dr.sc.ing. Irina Jackiva. Doctor of Sciences in Engineering and the author of more than 170 scientific publications on Statistics, Computer Science and Computer Modelling (Hirsch index is 7). She is a leading researcher at TTI and has been involved as a principal leader and executor in more than 20 international and 15 national projects. She is a member of the Editorial Board of “Transport” journal (WoS, SCOPUS, Lithuania); “Maintenance and Reliability” (SCOPUS), “Transport and Telecommunication Journal” (WoS, SCOPUS), etc. For more than 10 years she has been the Vice-Rector of Science at TTI, currently she is the Chairperson of the Board of Directors of TTI, Director of the Master's programme "Transport and Logistics", an expert of Latvian Council of Science. Since 2019 she is the Vice President of ECTRI (European Conference of Transport Research Institutes), an international scientific organisation, and for more than 15 years she has been a member of the Promotion Council in the field of Engineering and Technology.

Professor, Dr.sc.ing. Aleksandrs Grakovskis. Doctor of Sciences in Engineering and the author of more than 90 scientific publications on Electronics, Mathematical Modelling, Biometrics and Computer Networks (Hirsch index is 5). He is a Leading Researcher at TTI and has been involved in more than 15 international and 2 national projects as a principal leader and main executor, an expert of Latvian Council of Sciences. He is a member of the Editorial Board of the scientific journal "Transport and Telecommunication Journal" (WoS, SCOPUS). He is currently the Dean of the Faculty of Engineering, Director of the Master's programme in Electronics. Since 2008 he is a member of the Promotion Council in the field of Engineering and Technology.

Professor, Dr.hab.sc.ing. Igors Kabaškins. Igors Kabashkins is the Habilitated Doctor of Sciences in Engineering, the author of more than 400 scientific publications and 68 patents in the field of Electronics, Intelligent Transport Systems, Location and Navigation Systems for Air Traffic Control, Telecommunications (Hirsch index is 8). He is a Corresponding Member of the Latvian Academy of Sciences (since 1998), President of the Latvian Association for Transport Development and Education (since 2007), Full Member of the Institute of Electrical and Electronics Engineers (IEEE), member of New York Academy of Science, International Telecommunications Academy, International Academy of Astronautics, etc.

He has represented and continues to represent the country's interests at the international level, being the official representative of Latvia in the European Commission for Technological and Applied Scientific Research (1998-2014), since 2003 a member of the Committee of the Transport Research Centre of the Organisation for Economic Cooperation and Development (OECD). He is one of the founding members of the Institute of Transport and Telecommunications and was the Chairman and President of the Board of Directors of the Institute from 1999 to 2014. He is currently the Chair of the TTI Senate and Director of the Doctoral Programme in "Telematics and Logistics". He is a leading researcher at TTI and has been involved as a leader and executive director in more than 40 international and 20 national programmes and projects.

He is the Editor-in-Chief of "Transport and Telecommunication Journal" (WoS, SCOPUS), Editor-in-Chief of the scientific journals "Transport" (WoS, SCOPUS, Lithuania), Editorial Board Member of the scientific journal "Technological and Economic Development of Economy" (WoS, SCOPUS, Lithuania), "Journal of Aviation Technology and Engineering" (WoS, SCOPUS, USA), etc. Expert of Latvian Council of Sciences. Since 1994 he is the permanent Chairman of the Promotion Council at TTI in the field of Engineering and Technology, Telematics and Logistics.

Professor, Dr.sc.ing. Dmitry Pavlyuk. He holds a Master's degree in Computer Science and two Doctoral Degrees: in Economics (2005) and in Engineering (2015). He is the author of more than 50 scientific publications, 35 of them are indexed in Scopus, more than 150 citations (Hirsch index is 7). Expert of Latvian Council of Sciences. His research interests focus on Spatial Econometrics, Spatial Temporal Big Data Modelling and Machine Learning in Transportation. Since 2020 he is a principal leader of the Data Analytics and Artificial Intelligence Research Cluster, which carries out the research projects and studies commissioned by industry. He has 20 years of academic experience, leader of the study courses on Probability Theory, Mathematical Statistics, Econometrics, Operations Research and Data Analysis. Director of the Master's programme in Computer Science.

Emeritus Professor Dr.hab.sc.ing. Jurijs Tolujevs. He has more than 50 years of experience in research, teaching and project work in the field of Computer Simulation of Manufacturing, Transport and Logistics Systems. He worked at Riga Technical University until 2001, and then for about 20 years in Germany at the Fraunhofer Institute and the University of Magdeburg at the same time. He is the author and co-author of more than 160 scientific publications, 35 of which have been published in Scopus (Hirsch index is 11). Since 2007, Yuri Toluev has been a professor at TTI. Under his supervision 5 Doctoral students have defended their dissertations. He teaches courses in the Doctoral programme, which include state-of-the-art methods and tools for Computer Simulation of Manufacturing, Transport and Logistics Systems. The lectures are complemented by demonstrations of projects that Yuri Toluev carried out while working at the Fraunhofer Institute.

Professor Dr.sc.ing. Irina Pticina. Irina Pticina is the author of about 20 scientific publications in the field of Data Processing, Computer Graphics and Computer Modelling (Hirsch index is 3). She has been the leading researcher and principal executor of 8 international and 3 national projects. She has position of Academic Vice-Rector, Head of the Software and Information Systems Development Laboratory, Member of the Editorial Board of the journal “Research and Technology - Step into the Future” (ISSN 1691-2853).

Professor, Dr.sc.ing. Mihails Savrasovs. He has more than 30 scientific publications in the field of Artificial Intelligence, Information Systems, Simulation Modelling (Hirsch index is 6). He is a leading researcher and has been involved as a principal leader and executor in more than 10 international and 10 national projects. Expert of Latvian Council of Sciences. Member of the Editorial Board of the scientific journal “Transport and Telecommunication Journal” (WoS, SCOPUS). He is currently the Vice-Rector for Scientific and Academic Work, Director of the Master’s programme “Information Systems Management”. Since 2017 he is a member of the Promotional Council.

The academic staff involved in the implementation of the study programme are engaged in the scientific activities at the international level, improving their qualifications and carrying out the scientific research activities (see biographies of academic staff). Academic staff have the opportunity to improve their professional knowledge and gain valuable experience in a foreign higher education institution (through Erasmus, COST or projects mobility opportunities) in line with the European Higher Education Area Development Strategy, as well as through internships in the industrial enterprises.

Academic staff also continuously upgrade their qualifications through participation in the doctoral training at foreign universities and short-term research missions abroad.

Academic Staff	**Host institution**	**Country**	**Period**	**Purpose of visit**
Prof. Igors Kabaškins	Otto-von-Guericke-Universität Magdeburg	Germany	2014-2017	Guest lecturing for MSc and PhD students “Baltic Vector of Transport Development”
Prof. Igors Kabaškins	TTK University of Applied Sciences	Estonia	2015-2022	Guest lecturing for PhD students “Intelligent Transport Systems”

Prof. Irina Jackiva, Prof. Mihails Savrasovs, Prof. Irina Pticina	University of Thessaly	Greece	2016-2022	Scientific Short-Term-Staff-Exchange
Prof. Igors Kabaškins	Lulea University of Technology	Sweden	2018	Scientific Short-Term-Staff-Exchange
Prof. Irina Jackiva	Vilnius Gediminas Technical University	Lithuania	2017-2022	Scientific Short-Term-Staff-Exchange
Prof. Irina Jackiva	Fraunhofer Institute for Factory Operations and Automation	Germany	2017-2022	Short-Term-Staff-Exchange
Prof. Dmitry Pavlyuk	Deusto Institute of Technology, University of Deusto	Bilbao-San Sebastian, Spain	2018	Collaboration within the scope of postdoc project 1.1.1.2/VIAA/1/16/112
Prof. M. Savrasovs, Prof. Jurijs Tolujevs Prof. Irina Jackiva, Prof. Igors Kabaškins	Fraunhofer Institute for Factory Operations and Automation	Germany	2018-2022	Scientific Short-Term-Staff-Exchange
Pētniece Nadežda Spiridovska	Institute of Mathematics and Statistics & Reisiekspert / Conference Expert	Tartu, Estonia	2018	Participating in the 27th Nordic Conference in Mathematical Statistics (Nordstat2018) within the framework of postdoc project No. 1.1.1.2/VIAA/1/16/075

At the same time, the faculty members are also the visiting supervisors of doctoral students from the foreign universities, and the foreign Doctoral students themselves are interns at TTI.

Appendix 7.10 provides information on the internships of foreign Doctoral students at TTI (https://tsi.lv/research/activities/short-time-scientific-missions/).

The qualifications of the academic staff involved in the programme meet the requirements of the regulatory acts and ensure the achievement of the objectives and learning outcomes of the study programme and the corresponding study courses. Taking into account the above said, it can be stated that the academic staff involved in the implementation of the programme ensures the acquisition of high quality theoretical knowledge and research skills and professional experience that enable students to be successfully engaged in solving various research problems.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

During the reporting period, since the previous accreditation in the academic year 2012/2013, there have been some changes in the composition of the academic staff involved in the Doctoral programme "Telematics and Logistics".

	2012./2013.ac.year		2021./2022.ac.year	
	Ammount	LSC Experts	Ammount	LSC Experts
Professors	5	5	6	5
Associated Professors	2			
Assistant Professor	1			
Emeritus Professors			1	1
Guest Lectures				
Total	8	5	7	6

Academic staff who taught courses throughout the reporting period and are lead lecturers in compulsory and optional study courses:

- Professor I.Kabaškins (Scientific and legal framework of the Doctoral thesis)
- Professor I.Jackiva (Research Methodology, Intelligent Data Processing)
- Professor A.Grakovskis (Systems Theory, Business Intelligence & Data Visualisation)
- Professor J.Tolujevs (System Modelling)

Changes in the composition of lecturers are influenced by several factors: termination of employment with TSI or retirement. Several lecturers (3 professors) were in the pre-retirement age group during the previous accreditation. Currently, the programme is taught by several young lecturers (up to 45 years old). During the reporting period, the programme attracted 3 new professors who were elected to the position of professor in 2021: D.Pavluks, I.Pticina, M.Savrasovs, who are themselves graduates of this Doctoral programme, obtained their doctoral degrees in 2013-2015. These professors, along with the professors mentioned above, are now the lead instructors for the limited elective courses. They replaced teaching staff with doctorate degrees, but who were elected to the positions of docent and associated professor.

The composition of the academic staff or its changes does not include the guest lecturers who teach the study course "Latvian Language for Foreign Students" (Dr.sc.admin., A.Roskoša, Riga Technical University (RTU) professor) and if necessary – "Occupational Safety, Civil and Environmental Protection" (Mg.paed. V.Šlendins, Latvian National Defence Academy (NDA) lecturer), and have changed over time.

In general, it can be concluded that the changes in the academic staff involved in the Doctoral programme are positive, the relevant qualifications and experience of the academic staff in academic work ensure a high quality of education and it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

The scientific publications and participation in the research projects of the academic staff involved in the implementation of the Doctoral programme help to ensure the quality of the Doctoral programme. All leading professors have scientific publications indexed in Scopus or WoS CC.

	SCOPUS and Web of Science (situation on 01.08.2022)			
	Number of articles, in total	Number of articles in the reporting period	*h*-index	Citations Number
Prof. Irina Jackiva	59	44	7	147
Prof. Aleksandrs Grakovskis	29	22	5	66
Prof. Igors Kabaškins	57	51	8	191
Prof. Dmitry Pavlyuk	35	29	7	154
Prof. Irina Pticina	13	10	3	41
Prof. Mihails Savrasovs	28	24	6	95
Prof. Jurijs Tolujevs	41	7	11	328

For information on scientific publications of the academic staff involved in the implementation of the Doctoral study programme indexed in Scopus or WoS databases in the reporting period, see Appendix 7.11.

6 professors involved in the implementation of the Doctoral programme have been granted the

right of expert of the Latvian Scientific Council in Engineering and Technology, Civil Engineering and Transport Engineering:

- habil. sc. ing. Igors Kabaškins is an expert of the Latvian Scientific Council till 17.06.2023
- sc. ing.Aleksandrs Grakovskis is an expert of the Latvian Scientific Council till 17.06.2023
- sc. ing. Irina Jackiva is an expert of the Latvian Scientific Council till 17.06.2023
- habil. sc. ing.Jurijs Tolujevs is an expert of the Latvian Scientific Council till 03.09.2023
- sc. ing. Mihails Savrasovs is an expert of the Latvian Scientific Council till 17.06.2023
- sc. ing. Dmitry Pavlyuk is an expert of the Latvian Scientific Council till 17.06.2023

At the same time, they are all members of the TTI Promotion Council, where graduates of the Doctoral programme "Telematics and Logistics" can defend their theses.

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

All supervisors of Doctoral theses at TTI are actively involved in various research projects, both local and international, as project leaders and performers. More about the involvement of teaching staff in the implementation of research projects, see the description of criteria 2.4.2-2.4.3 of the description of the study direction and Appendix No.13, where the source of the project's funding is also provided.

Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer (ePIcenter).

HORIZON 2020, 01.06.2020- 31.12.2023, 6 848 575 EUR (https://tsi.lv/projects/enhanced-physical-internet-compatible-earth-friendly-freight-transportation-answer/).

Project leader Professor I.Jackiva, chief executor Professor J.Tolujevs.

Workforce Europe – Transformation agenda for transport automation (We-Transform).

HORIZON 2020, 01.12.2020-- 30.11.2023. 2 499 396,25 EUR (https://tsi.lv/projects/workforce-europe-transformation-agenda-for-transport-automation-we-transform/).

Project leader Professor I.Jackiva

Fundamentals of Design Competence for Our Digital Future

H2020-MSCA-ITN-2020 (Marie Skłodowska-Curie Innovative Training Networks), 01.01.2021-31.12.2024. 4206200,40 EUR (https://tsi.lv/projects/fundamentals-of-design-competence-for-our-digital-future/).

Project leader Professor I.Jackiva, chief executor Professor I.Pticina.

Innovation Grants for Students iDEAHUB.

ERDF, 01.09.2021- 30.11.2023. 543 024.91 EUR (https://tsi.lv/projects/project-innovation-grants-for-students-at-the-institute-of-transport-and-communications-ideahub-nr-1-1-1-3-21-a-006/).

Project leader Professor M.Savrasovs, chief executor Professor I.Pticina and Professor . D.Pavlyuk.

Intelligent Transport and Transport Management study module (INTELTRANS).

INTERREG Central Baltic. 01.04.2020-30.09.2022. **505 938 EUR (**https://tsi.lv/projects/intelligent-transport-and-transport-management-study-module-inteltrans/)

Project leader Professor I.Kabaškins, chief executor Professor J.Tolujevs.

INGENIOUS-Strengthening Digital Pedagogy Skills and Competencies of Educators.

ERASMUS+, 01.03.2021- 28.02.2023. 299611.00 EUR (https://tsi.lv/projects/ingenious-strengthening-digital-pedagogy-skills-and-competencies-of-educators/)

Project chief executor Professor I.Kabaškins.

Ecosystem for European Education Mobility as a Service: Model with Portal Demo (eMEDIATOR). ERASMUS+, 01.11.2021- 31.10.2023. 294145,00 EUR (https://tsi.lv/projects/ecosystem-for-european-education-mobility-as-a-service-model-with-portal-demo/).

Project chief executor Professor I.Kabaškins.

Spatiotemporal urban traffic modelling using big data,

ERAF, 01.10.2017- 30.09.2020. (https://tsi.lv/projects/project-spatiotemporal-urban-traffic-modelling-using-big-data-1-1-1-2-viaa-1-16-112/)

Project leader Professor I.Jackiva, chief executor Professor D.Pavlyuk.

COST Action TU1408 Air Transport and Regional Development (ATARD).

COST, 25.03.2015-24.03.2019. (https://tsi.lv/projects/cost-action-tu1408-air-transport-and-regional-development-atard/).

Project leader Professor I.Kabaškins.

Digitally supported and virtual study practices for modern logistic systems (DIGILOG). ERASMUS+, 01.09.2018- 31.08.2021. 197 673 EUR. (https://tsi.lv/projects/digitally-supported-and-virtual-study-practices-for-modern-logistic-systems-digilog/)

Project leader Professor I.Kabaškins.

COST Action CA16222: Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport. COST, 13.10.2017- 12.10.2021. (https://tsi.lv/projects/cost-action-ca16222-wider-impacts-and-scenario-evaluation-of-autonomous-and-connected-transport/)

Project leader Professor I.Jackiva.

Smart Logistics and Freight Villages Initiative (SmartLog). INTERREG Central Baltic, 01.09.2016- 31.05.2020. 2 194868.33 EUR (https://tsi.lv/projects/smart-logistics-and-freight-villages-initiative-smartlog/)

Project leader Professor I.Kabaškins.

Harmonised and Modernised Multidisciplinary Railway Education (EDU-RAIL).

INTERREG Central Baltic, 01.10.2015- 30.09.2018. 358 402,10 EUR. https://tsi.lv/projects/harmonised-and-modernised-multidisciplinary-railway-education-edu-rail/

Project leader Professor I.Kabaškins, chief executor Professor A.Grakovskis.

Enhancing excellence and innovation capacity in sustainable transport interchanges (ALLIANCE).

HORIZON 2020, 01.01.2016- 31.12.2018. 989 331.25 EUR (https://tsi.lv/projects/enhancing-excellence-and-innovation-capacity-in-sustainable-transport-interchanges-alliance/)

Project leader Professor I.Jackiva, chief executors Professor A.Grakovskis, Professor I. Kabaškins, Professor D. Pavlyuk, Professor M.Savrasovs, Professor I.Pticina, Professor J.Tolujevs.

COST Action TU1305 Social networks and travel behaviour.

COST, 23.03.2014- 22.03.2018. (https://tsi.lv/projects/cost-action-tu1305-social-networks-and-travel-behaviour/)

Project leader Professor M.Savrasovs.

Implementation of Software Engineering Competence Remote Evaluation for Master Program Graduates (ISECRET).

ERASMUS+, 01.09.2015- 31.08.2017. (https://tsi.lv/projects/implementation-of-software-engineering-competence-remote-evaluation-for-master-program-graduates-isecret/)

Project chief executor Professor I.Kabaškins.

Latvian National Research Programme "The next generation of information and communication technologies (NexIT)". 01.09.2014. – 28.02.2018

Project leader Professor A. Grakovskis, chief executors Professor I.Kabaškins and Professor M.Savrasovs.

Learning with ICT use (LEARN IT).

ERASMUS+, 01.09.2014- 31.08.2017. (https://tsi.lv/projects/learning-with-ict-use-learn-it/)

Project chief executor Professor D.Pavlyuk.

EU-wide Establishment of Enduring National and European Suppor Networks for Sustainable Urban Mobility (ENDURANCE).

IEE Programme, 01.01.2013- 01.01.2016. 2 612 424 EUR (https://tsi.lv/projects/eu-wide-establishment-of-enduring-national-and-european-suppor-networks-for-sustainable-urban-mobility-endurance/)

Project leader Professor I.Jackiva, chief executor Professor I.Kabaškins.

Policy Learning in Information Technologies for Public Transport Enhancement (POLITE).

INTERREG Central Baltic, 01.01.2012- 01.01.2014. (https://tsi.lv/projects/policy-learning-in-information-technologies-for-public-transport-enhancement-polite/)

Project leader Professor I.Jackiva, chief executor Professor I.Kabaškins.

Enhancing the transfer of Intelligent Transportation System innovations to the market (T-TRANS).

FP7, 01.01.2012- 01.01.2014. (https://tsi.lv/projects/fp7-enhancing-the-transfer-of-intelligent-transportation-system-innovations-to-the-market-t-trans/)

Project leader Professor I.Kabaškins, chief executors Professor I.Jackiva and Professor M.Savrasovs.

COST Action TU1306: Fostering knowledge about the relationship between Information and Communication Technologies and Public Spaces supported by strategies to improve their use and attractiveness (CYBERPARKS).

COST, 28.04.2014- 27.04.2018. (https://tsi.lv/projects/cost-action-tu1306-fostering-knowledge-about-the-relationship-between-information-and-communication-technologies-and-public-spaces-supported-by-strategies-to-improve-their-use-and-attractiveness-cyb/)

Project leader Professor I.Jackiva.

COST Action TU1004: Modelling Public Transport Passenger Flows in the Era of Intelligent Transport Systems. COST, 01.01.2011- 01.01.2015.

(https://tsi.lv/projects/cost-action-tu1004-modelling-public-transport-passenger-flows-in-the-era-of-intelligent-transport-systems/)

Project leader Professor I.Jackiva, chief executor Professor M.Savrasovs.

Latvian National Research Programme “Local Resouces Long-Term Utilization. New Products and Technologies (NatRes)”. Project Nr. 4. “Development of the Long-Term Programme of the Latvian Transport System Harmonization” (LATRANS)”. 2010-2014.

Project leader Professor I.Kabaškins.

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for cooperation between the academic staff, which contributes to the development and interconnection of the study courses. The development of the study courses is carried out on a regular basis, based on suggestions made by students, on industry development trends, and on the latest results of research, scientific activities and innovations.

In the process of implementation of the study courses and scientific work, regular meetings of the academic staff are held to exchange experience on the topics of study courses, results of scientific work, new developments in research, etc. Discussions are used to develop and improve the content of studies, presupposing the mutual agreement on topics, emphases, responsibilities and compliance with regulatory requirements. All academic staff involved in the course of teaching are involved in the process of coordinating the courses of study, thus ensuring that the topics covered in the study programme are continuously developed and updated in close cooperation with each other.

The achievement of the objectives and results of the study courses and the programme within the framework of the programme is implemented through regular seminars and discussions of the academic staff on the study results and the basic principles of quality assurance. Therefore, it can be said that a mechanism for mutual cooperation between academic staff has been established, and it contributes to the development and interconnection of the study courses.

The study programme is designed to ensure the sequential development of knowledge, skills and competences based on individual and group work, continuous communication between Doctoral students and their supervisors.

The interconnection of courses is indicated in section 7.2.1 of the report. First year comprises the general courses, taught by all the academic staff involved in the doctoral process. At the end of the first year, at least one publication is prepared and submitted for publication, and a paper is prepared and presented at an international conference. The research work is supervised by the supervisor. The second year is devoted to the specialised subjects and doctoral seminars and to the preparation of the doctoral thesis.

The third year is devoted to the scientific work, research, publication of research results, participation in exchange and mobility projects. Individual work of the doctoral student is intensified, cooperation with the supervisor is ensured as well as regular opportunities to meet other doctoral students for experience and knowledge transfer. Work on scientific publications continues and international cooperation of the young scientist is developed. This year ends with the submission of the doctoral thesis for the defence.

The information contained in the courses of study forms a logical interconnection, ensuring the upward development of students' knowledge and skills.

The following activities are used to improve the content and quality of the study programme, as well as to ensure mutual cooperation between teaching staff, exchange of experience and information related to the study work:

Meetings of the academic staff (at least once a semester); Research and Doctoral Council meetings (at least once a semester); Doctoral Council meetings (as needed); Doctoral seminars; Doctoral attestations at the Faculty (2 times a year); Seminars, conferences, workshops, etc.

A total of 7 faculty members with doctoral degrees are involved in the implementation of the doctoral programme, all of them are also the supervisors of the doctoral theses.

The number of students in the last 3 academic years has been respectively: (2019/2020) – 16, (2020/2021) – 17 and (2021/2022) – 21, and taking into account that several Doctoral students are on an academic leave, the programme has therefore an average of 2 students per faculty member.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Appendix 7.5 Diplom PhD.pdf	7.5.pielikums. Diploms.pdf
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	7.8.pielikums.TSI_dokt_250_ENG.pdf	7.8.pielikums. AIP apliecinājums.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 7.1. Statistics on the students in the reporting period.docx	7.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard		
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)	Annex 7.12. Compliance with the specific regulatory framework (1).docx	7.12.pielikums. Atbilstiba normativajiem dokumentiem (1).docx
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 7.2. Mapping of the study courses.xlsx	7.2.pielikums. Studiju kursu kartejums phd 2301.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 7.3. The curriculum of the study programme.zip	7.3.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 7.4. Descriptions of the study courses modules.zip	7.4.pielikums. kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)	Annex 7.6. Confirmation (experts by the Latvian Council of Science).pdf	7.6.pielikums. Apliecinājums par LZP eksperta tiesībām.pdf
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 7.7. Confirmation (complies with the requirements of the Law on Higher Education Institutions).pdf	7.7.pielikums. Apliecinājums atbilstība AL prasibām.pdf

Computer Engineering and Electronics (45523)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Computer Engineering and Electronics*
Education classification code	*45523*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Aleksandrs*
Surname of the study programme director	*Grakovskis*
E-mail of the study programme director	*Grakovskis.A@tsi.lv*
Title of the study programme director	*Dr.sc.ing.*
Phone of the study programme director	*26562715*
Goal of the study programme	*Prepare academically educated specialists in electronics and computer engineering who can continue their doctoral studies, start working in universities, scientific research institutes, relevant state institutions that require master's level knowledge in electronics, as well as in electronic equipment manufacturing and operation companies*
Tasks of the study programme	*• to prepare master students for independent scientific, pedagogical and scientific-practical work in the field of electronic and computer engineering means and technologies; • to develop research skills of mathematical description and transformation of signals and disturbances in communication and telecommunication systems and networks; • to develop skills in the application of modern analysis and synthesis methods of electronics, computer engineering, telecommunication systems and networks; • to develop modelling skills of electronic robotic systems, telecommunications and computer networks; • to develop skills to set goals, formulate and solve scientific tasks, prepare research results for publication.*

Results of the study programme	*• Demonstrates in-depth knowledge of current problems in the field of electronics, robotics and telecommunications and possible solutions based on a set of concepts, principles and methods in the context of vaguely formulated tasks, and can apply them to assess and solve modern industry and social problems in accordance with legal, ethical and social standards.* *• Able to select, use and critically evaluate methods, hardware and software to effectively solve the problems of development and research of embedded, autonomous and robotic systems, technologies and modelling environments for the design of communication networks and their cyber defence.* *• Capable of extending the functionality and software of today's embedded electronics and communications systems, as well as creating application software and ready-to-use technical solutions.* *• Using methods of digital signal and image processing, machine learning, as well as methods of experiment planning and data processing, can develop descriptive, mathematical and functional models (prototypes) for designing technical solutions.* *• Able to independently formulate and solve complex engineering problems that require deep professional knowledge, using modern methods of research and creation of new knowledge in the field of computer engineering.* *• Able to analyse and critically evaluate the technical and economic efficiency of engineering solutions and formulate requirements for electronic systems, applications and operating rules based on relevant documentation and protection of intellectual property.* *• Able to effectively visualize and present the results of engineering projects to various audiences using modern information technologies.* *• Able to work and lead teams, demonstrating leadership and results-oriented thinking, and taking responsibility for team performance.* *• Demonstrates the ability to improve constantly their knowledge, skills and competencies in the field of computer engineering and electronics, to conduct self-education using modern pedagogical approaches*
Final examination upon the completion of the study programme	*Master's Thesis*

Study programme forms

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*

Admission requirements (in English)	*Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields with a study duration at least 120 CP Second level professional higher education or Bachelor degree in transport engineering, metalworking, with at least 1 year of professional experience in electronics and automation, an interview with the study programme director and an entrance exam in the specialisation.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields with a study duration at least 120 CP Second level professional higher education or Bachelor degree in transport engineering, metalworking, with at least 1 year of professional experience in electronics and automation, an interview with the study programme director and an entrance exam in the specialisation For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields with a study duration at least 120 CP Second level professional higher education or Bachelor degree in transport engineering, metalworking, with at least 1 year of professional experience in electronics and automation, an interview with the study programme director and an entrance exam in the specialisation*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields with a study duration at least 120 CP Second level professional higher education or Bachelor degree in transport engineering, metalworking, with at least 1 year of professional experience in electronics and automation, an interview with the study programme director and an entrance exam in the specialisation. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*The second level professional higher education or bachelor's degree in engineering in electronics and automation, electrical engineering, information and communication technologies, robotics or other related fields, if the bachelor's degree was obtained through at least four years of study in the amount of 160 CP.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*The second level professional higher education or bachelor's degree in engineering in electronics and automation, electrical engineering, information and communication technologies, robotics or other related fields, if the bachelor's degree was obtained through at least four years of study in the amount of 160 CP.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - english

Study type and form	*Full time studies*

Duration in full years	*1*
Duration in month	*6*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*The second level professional higher education or bachelor's degree in engineering in electronics and automation, electrical engineering, information and communication technologies, robotics or other related fields, if the bachelor's degree was obtained through at least four years of study in the amount of 160 CP. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*The second level professional higher education or bachelor's degree in engineering in electronics and automation, electrical engineering, information and communication technologies, robotics or other related fields, if the bachelor's degree was obtained through at least four years of study in the amount of 160 CP. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Electronics and Automation*

Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

No.	Parameter	Changes made in the period since the previous accreditation	Changes made in the process of accreditation
1.	Field of Study		Changed from "Master of Engineering in Electronics" to "Computer Engineering and Electronics"
2.	Name of the study programme		---
3.	The code of the study programme in accordance with the Latvian Classification of Education		---
4.	Type and level of the study programme		Programme implementation option in the amount of 60 CP has been added

5.	Amount of the study programme (KP)		Programme's option in the amount of 60 CP with the duration of implementation 1 year 6 months in full-time studies and 2 years in part-time studies
6.	Form, type, duration of programme implementation		Latvian and English The programme was previously also accredited with Russian as a language of instruction, the last students studying in Russian will graduate from the programme in June 2023. *Article 49 of the Transitional Regulations of the Law on Higher Education, according to which it is prohibited to enrol students for studies in Russian after January 1, 2019.*
7.	Language of instruction		---

8.	Place of implementation	----	Due to a change in the personnel composition, from January 2022 the director of the programme is Professor Aleksandrs Grakovskis, Dr.sc.ing., who is also a long-term leading academic staff of the programme
9.	Director of the study programme		Clarified and supplemented, taking into account the short implementation variant of the programme. Added to the long version: Second-level professional higher education or bachelor's degree in transport, metalworking or other fields, with at least 1 year of professional experience in the field of electronics and automation, discussions with the director of the study programme and entrance exam in the specialty.

10.	Admission requirements		Changed from "Engineering Master's Degree in Electrical Science" to "Engineering Master's Degree in Electronics and Automation", clarifying it according to MK regulations no. 322 "Rules on Latvian education classification" for the group of programs with code 523.
11.	Awarded degree		Changed according to the changed name and content of the programme, taking into account the changes in the demand of the modern labour market and current events in the industry.
12.	The goal of the study programme		Changed according to the changed name and content of the programme, taking into account the changes in the demand of the modern labour market and current events in the industry.

13.	Tasks of the study programme		Learning outcomes have been refined in line with the goal of the programme, updated study course outcomes and European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) requirements for level 7, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.
14.	Learning outcomes		---

Changes to the name of the programme

The programme was licensed more than 20 years ago with a name that duplicated the academic degree to be awarded in the programme Master of Engineering in Electronics. First of all, this caused inconvenience both for the university and for the applicants and for the students, since such a long name duplicating a degree is not very memorable. Secondly, it does not reflect the current trends where electronics, telecommunications, automation and robotics devices are combined in a common system controlled by microprocessors using digital data processing. This is called ***Computer Engineering***. Thirdly, this is the name used for programmes in this field in the international environment and also in programmes implemented by the universities in the Baltic Countries. For example, Master programme in “Robotics & Computer Engineering” of the Estonian University of Tartu or Master programme in “Computer Engineering” of TU Delft (the Netherlands).

Therefore, the name of the study programme was changed to **“Computer Engineering and Electronics”.**

Changes in the awarded degree

Changed from “Master of Engineering in Electrical Engineering” to “Master of Engineering in Electronics and Automation”, specifying it in accordance with Cabinet of ministers Regulation No. 322 “Regulations on the Classification of Education in Latvia” for the group of programmes with code 523. The content of the Master programme ensures the development of competences of specialists in various fields of electronics and robotics systems in the industry.

Changes to Admission Requirements

Considering introduction of the short version of the program for 60CP, the admission requirements has been updated. For short version the students with Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields, or second-level professional higher education and professional Bachelor degree in electronics and automation, electrical engineering, information and communication technology, robotics with a study duration of at least 160 CP are allowed.

For a long version of the program are enrolled students with Bachelor degree in engineering in electronics and automation, electrical engineering, information and communication technology, robotics or other related fields, or second-level professional higher education and professional Bachelor degree in electronics and automation, electrical engineering, information and communication technology, robotics with a study duration less than 160 CP are allowed (to have at least 5 years, according to the national regulation).

In addition, for a long version of the program the students with engineering education in transport, metalworking or other related fields, but whose professional work experience is directly related to electronics and automation (with 1y experience). In this case, the applicant must have an interview with the program director and must pass an entrance examination in the specialization.

Changes in study duration

The programme was supplemented with a short version of the programme in the amount of 60 CP, taking into account that according to Article 57 of the Law on Higher Education Institutions, the total duration of full-time Bachelor and Master studies is not less than 5 years. The amount of the TTI academic Engineering and Natural Sciences programmes is 160 CP. The short version of the programme in the amount of 60 CP will make the programme more competitive in the Latvian educational services market; it will also allow attracting the foreign students. Research was carried out and it was found that in several foreign universities the duration of Master level study programmes in this field is less than 2 years, for example, https://www.masterstudies.com/MSc-in-Engineering-(Electrical-and-Electronic)/United-Kingdom/Wrexham-Glyndwr-University/

Changes in the structure of the programme

The main changes in the structure of the Master programme “Computer Engineering and Electronics” are related to the expansion of the horizon of knowledge and skills of the students, in accordance with the development trends in the field, including the study courses related to robotics, computer vision, artificial intelligence, design of SAF circuits and embedded systems.

The programme includes the course “Robotics and Autonomous Systems Design”, which provides students with knowledge and skills for the construction of the autonomous systems with modern electronics and telecommunication solutions, provides practical skills in in planning and carrying out development, oral and written presentation of results of scientific (engineering) projects, scientific discussion.

Such changes contribute to the formation of students' practical scientific competences and improve the interdisciplinary connection in the programme.

The programme includes a course on "Critical Thinking and Innovation" oriented on the development of basic critical thinking skills.

The programme combines the previously included courses "Scientific Research Methodology" and "Scientific Seminar" into one 6 CP course "Research Methodology", which provides students with the skills necessary to carry out scientific work, which is the basis for developing the Master thesis, and helps the student to choose an appropriate research topic, to carry out a literature review of scientific publications and to apply the principles of analysis and evaluation in his/her research.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The name of the Master study programme "Computer Engineering and Electronics" indicates that the programme belongs to the Engineering and Technology branch group Electrical Engineering, Electronics, Information and Communication Technologies and thus logically fits into the study field Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science. Successful completion of the programme leads to the award of a Master of Engineering degree in Electronics and Automation, which complies with the Cabinet of Ministers Regulation No. 322 "Regulation on the Classification of Education in Latvia", and also indicates the content of the programme and the programme's affiliation to the thematic field of education "Engineering and Technology".

The Master programme "Computer Engineering and Electronics" is aimed at training specialists for industry and scientific organisations in the field of Computer Engineering, which includes the study, creation and application of various electronic devices and systems with computer (including remote) control. In modern realities, this means the convergence and synergy of such traditional areas of knowledge as Electronics, Telecommunications, Computer Technology, Information Technology and Computer Science. This is clearly reflected in the structure of the programme, which contains the training courses from different fields of knowledge, in which separate thematic groups can be distinguished:

- Electronics ("SAF circuit design", "Digital Signal Processing Algorithms and Systems", "Embedded Systems")
- Telecommunications ("Digital Telecommunication Technologies");
- Computer Control ("Artificial Intelligence", "Advanced Artificial Intelligence", "Robotics and Autonomous Systems Design");
- Information technology ("Cyber Security and Data Protection");

- Computer Science ("Intelligent Data Processing", "Computer Vision and Image Processing").

Therefore, the Master programme "Computer Engineering and Electronics" fully corresponds to the field of the study "Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Management and Informatics".

One of the most popular areas of the graduate theses of the Master's programme " Computer Engineering and Electronics " is the automation of control systems of processes in industry, transport, life support systems ("smart" home), etc. by means of microprocessor-based electronic control systems and sensor networks. In the course of training, this is reinforced by the following groups of training courses delivered within the programme implementation:

- Automation: "Robotics and Autonomous Systems Design", "Embedded Systems", "Artificial intelligence", "Advanced Artificial Intelligence";
- Electronics: " SAF Circuit Design " , ""Digital Signal Processing Algorithms and Systems ", "Embedded Systems".

Therefore, the Master programme " Computer Engineering and Electronics " fully corresponds to the group of the study programmes "Electronics and Automation" with code 523, which is included in the thematic field of education "Mechanical Engineering and Technologies ", which is a part of the thematic group "Mechanical Engineering, Production and Construction".

The aim and objectives of the Master's programme "Computer Engineering and Electronics", as well as the study results obtained during the study, correspond to the seven level of the Latvian Education Classification (the Cabinet of Ministers Regulation No. 322 "Regulations on the Latvian Education Classification").

The tasks defined in the study programme are aimed at achieving the programme objective "to prepare academically educated specialists in electronics and computer engineering who can continue their doctoral studies, start working in universities, scientific research institutes, relevant state institutions that require master's level knowledge in electronics, as well as in electronic equipment manufacturing and operation companies" and ensuring the study results.

The achievable study outcomes of the study programme are formulated using a student centred approach, defining in a structured and detailed manner the knowledge, skills, competences that the student possesses and which the student is able to use and implement after graduation.

The study programme is aimed at preparing the specialists in electronics and automation with advanced knowledge in the field of computer engineering. Upon completion of the programme, the graduates are able to identify the content of an engineering problem, based on knowledge of electronics and automation, electrical engineering, information and communication technologies, robotics, computer science, formulate an engineering research task, plan and conduct experiments, analyse data, perform modelling and design of intelligent systems, develop analytical, algorithmic, engineering or organisational problem solutions, based on Latvian and European Union regulatory documents and legislation, applying modern approaches, technologies, hardware and software.

The study programme is well integrated with the students' engineering education previously acquired by the student in other industries, since it provides integrated knowledge on the assessment and optimisation of interactions between different fields and processes. The acquisition of the skills and knowledge provided by the programme is ensured by top-level academic and scientific staff (experts from the Latvian Science Council and European-level experts in the fields of transport, engineering and technology science, data processing), who are involved in the provision of engineering solutions at national and European level on a daily basis.

The carried out mapping of the study courses for the achievement of the study programme learning outcomes made it possible to implement an in-depth analysis and specification of the learning outcomes of individual study courses. The aims, objectives and planned learning outcomes (knowledge, skills, and competences) of the study programme “Computer Engineering and Electronics” are interlinked and the probability of achieving them is very high.

The admission requirements are determined in the TTI Admission Regulations and are based on the following normative acts: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the Cabinet of Ministers Regulation No. 846 of October 10, 2006 “On Requirements, Criteria and Procedures for Admission to Study Programmes”.

The Master study programme admits students 1) with a Bachelor degree in electronics and automation, electrical engineering, information and communication technologies, robotics or other related fields, or a second-level professional higher education and a professional Bachelor's degree in electronics and automation, electrical engineering, information and communication technologies, robotics; 2. a second level of professional higher education or a Bachelor degree in engineering in transport, metalworking or other related fields, and at least 1 year of professional work experience in the field of electronics and automation. In this case, the applicant must have an interview with the programme director and must pass an entrance examination in the specialisation

The study programme is implemented in Latvian and English. Foreign applicants are matriculated based on the test score of at least B2 level by an internationally recognised testing body or the TTI entrance exam in English of at least B2 level, except for cases where the previous education was acquired in English.

Such preparation of the applicants in their previous education, motivation to obtain higher education and organisation of the study process, TTI is able to ensure the achievement of the programme learning outcomes and to award the Master of Engineering in Electronics and Automation upon graduation from the programme.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The Master programme “Computer Engineering and Electronics” is classified as belonging to the thematic field “Engineering and Technology” and to the field of smart specialisation “Information and Communication Technologies” (STEM). The Ministry of Education and Science considers that the specified field is an area with a direct horizontal contribution to the development of other smart specialisation areas - Bioeconomy, Biomedicine, Smart Materials and Technologies, Smart Energy - and plays a key role in promoting economic the transformation of the national economy in order to promote the growth of high and medium-high technologies in the export of Latvian goods and services. In the field of specialisation in Information and Communication Technologies (ICT), Latvia has developed the research and innovation in the following thematic niches (there indicated only those, which correspond to the TTI study programmes and research pillars of the TTI): Algorithms, Machine Learning, Intelligent Control Systems, Electronics, Smart Sensors and Internet of Things, Robotics, Big Data, Data Storage, Transmission and Systems. This indicates that the proposed study programme will be in line with the smart specialisation area.

Since 2010, the production of electrical and optical equipment has been the fastest growing sector of the manufacturing industry in Latvia, the share of which in the total output of the manufacturing industry has increased from 3.7% in 2009 to 8.5% in 2021, when almost 90% of all products produced in the sector was exported.

In the informative report of the Ministry of Economy of the Republic of Latvia on medium- and long-term forecasts of the labour market (https://www.em.gov.lv/lv/media/14720/download?attachment, Only in Latvian), it is stated that "By 2040 the demand for labour will continue to shift in favour of the demand for specialists with higher education". By 2027, the gap between labour demand and supply of specialists with higher education could increase to 37 thousand professionals. The demand and supply of education in the "Engineering and Technologies" sector in 2030 is estimated to be 106% (Balance of demand and supply of workforce with higher education - EM) - Supply - 32.6 thousand, Demand - 33.9 thousand, Shortage - 1.3 thousand.

In the informative report of the Ministry of Economy of the Republic of Latvia on medium and long-term forecasts of the labour market it is stated that if the existing structure of the higher education offer is maintained, the most significant labour shortage in the higher education group is expected to be for specialists with education in the fields of Engineering, Natural Sciences and ICT (STEM). The shortage of the specialists with the right qualifications could reach 14 thousand by 2027, mainly in areas such as Architecture and Construction, Computer Science, Physics and Engineering.

According to CV.LV data (as of 31.05.2022), there are 887 vacancies in the field of Information Technology only in Riga. The employment rate of higher education graduates (CSP) according to the Education Development Guidelines 2021-2027 "Future Skills for Future Society "ACTION PLAN 2021-2023 is planned to be 80% (2024), while in 2020 the employment rate for the graduates of the Master programme in "Computer Engineering and Electronics" of TTI was already 80.5%.

Based on data from the Monitoring Tool for Graduates of Higher Education Programmes (https://www.viis.gov.lv/monitoringa-riki, Only in Latvian), in 2020 the income of graduates of 2019 in the STEM sector was estimated to be EUR 17,104 (average weighted income). The income of TTI graduates in Engineering and Technology was estimated to be 15,689 EUR.

The demand from the side of foreign students for TTI's STEM programmes is increasing every year (an average of 30% per year), which shows that the existing programmes have export potential (this applies to Bachelor, Master and Doctoral level study programmes).

Looking at the relevance of the study programme, it can be concluded that the TTI Master programme in "Computer Engineering and Electronics" is fully corresponds to the contemporary world trends in the field of ICT and engineering, as well as the most important development directions of the economy of Latvia in accordance with smart specialization. In the territory of Latvia the study programmes of the Faculty of Engineering of TTI occupy a certain significant market share (TTI is the only university among the higher education institutions that implements STEM programmes that do not have state budget funding). Three higher education institutions in Latvia (RTU, Ventspils University, Liepaja University) prepare produce the specialists similar to the graduates of the Master programme "Computer Engineering and Electronics"; however, based on the currently available programmes descriptions, only the programme offered by TTI combines modern sub-branches of Computer Engineering: Smart Electronics, Digital Embedded Systems, Artificial Intelligence, Signal and Image Processing, Computer Security and Robotics. The programme offered by TTI was developed in close cooperation with industry representatives. The quality level of the competences acquired by the graduates of TTI provides them with the opportunity to find jobs not only in Latvia, but also in foreign countries (EU, USA, Germany, Great Britain, etc.).

In general, it should be concluded that the Master degree programme "Computer Engineering and Electronics" meets the needs of both Latvia's smart specialization and the national economy. The analysis of development plans, economic and societal needs of the Republic of Latvia in the era of digitalisation clearly indicates the need to continue and expand the training of specialists in the Master programme “Computer Engineering and Electronics”.

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The Master study programme “Computer Engineering and Electronics” (former name is “Master of Engineering in Electronics”) is licensed and accredited for full-time face-to-face and part-time studies with Latvian, Russian and English as languages of instruction.

The number of students in the programme has never been very high, in some years only 2 to 3 students matriculating. Until now only a few students have had the desire to study in the state language, it is a reason why no study groups with the state language as a language of instruction were opened in the programme. This is due to the wide range of engineering programmes at Riga Technical University, where state budget places are available for the students. However, this has not been an obstacle for some students to continue their studies in the Master programme of TTI after graduation from the Bachelor level programmes of RTU.

Students from foreign countries were admitted for studies in English and Russian until 2019, and many foreigners, mostly from former post-Soviet countries, took the opportunity to study in Russian. The academic year 2022/2023 is the last year when the study programme is conducted in Russian. Students have been informed about this, and if for some reason they do not graduate from the programme, students will be offered the opportunity to continue their studies in Latvian or English.

Foreign students are admitted to the programme only from the academic year 2018/2019, and in the last reporting year there were 60% of foreign students in the programme. By country of origin they were as follows: Arab Republic of Egypt -1, India - 2, Pakistan - 2, Ukraine - 1.

As a private educational institution, TTI provides only fee-based studies. Similar programmes are implemented by Riga Technical University, where the students have access to the state budget study places. This demonstrates the steady and constant interest in the TTI study programme and the relevance of the programme, taking into account the impact of the ICT sector on the national economy.

The statistical data show that with a relatively small number of students, the number of students who do not complete their studies is also small - 1 or 0 per year. Since people who are already working in the industry choose to study for a Master degree in Engineering, the reasons for dropping out are legitimate: family circumstances (leaving the country), a change of the professional field of work or inability to combine work and studies, or in some cases due to illness.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study program has been developed pursuant to Regulation No. 240 of the Cabinet of Ministers of 13 May 2014 on the National Academic Education Standard, the compliance can be seen in Appendix 5.2.

The study direction and the study programs included in it have been developed taking into account the mutual connection and sequence of study courses. This enables to achieve the goal of the study program and provide a set of knowledge, skills and competences in accordance Level 7 of the European Qualifications Framework of Latvian Education Classification.

The Master programme in "Computer Engineering and Electronics" at TTI is designed for students with a Bachelor degree in Engineering or Computer Science and takes into account the societal trends towards digitalisation, increased productivity, cheaper products and reduced environmental impact.

The programme provides a broad knowledge of Embedded Systems, Robotics or Telecommunication Technologies. The graduates can work in companies or research centres related to their field of study. The Master programme focuses on the development of high-tech systems and equipment. It combines both hardware and software. Its main specialisation is in Embedded Electronics Systems, Robotics and Communication Technologies.

In order to ensure the attainment of the aim of the study program, the study program contains nine elements of knowledge, skills and competencies to be acquired. Considering the achievement of learning outcomes, there have been identified specific study courses and the amount of knowledge, skills and competencies to be acquired).

The correlation of the aims and learning outcomes of the study program with the learning outcomes of specific study courses can be found in each study course description, which provides a description of the course content, course plan, study requirements, learning outcomes, study methods, literature and other sources.

The comparison of the Master programme with similar Master programmes in Computer Engineering at TU Delft (the Netherlands) and TU Tartu (Estonia) shows the similarity of the TTI Master programme in terms of its objectives, the number of credits and its structure. The programme consists of 2 years of study (80 CP or 120 ECTS) and comprises a block of general science courses (compulsory courses), a block of courses for the acquisition of missing knowledge and deepening of the existing knowledge in the fields of Signal and Image Processing, Embedded Systems, Design of Robotic Systems and High-Frequency Devices (compulsory optional study courses), and a block of academic study courses (free elective course).

The study programme contains the compulsory courses in the amount of 26 CP (32,5%), the compulsory optional study courses in the amount of 28 CP (35%) and free choice (block C) study courses in the amount of 6 CP (7,5%).

The compulsory part of the study programme and the limited elective part of the study programme cover courses in the field of engineering for the application of the artificial intelligence principles in solving problems in Electronics, Telecommunications, Robotics (Research Methodology - 6 CP, Intelligent Data Processing - 4 CP, Digital Signal Processing Algorithms and Systems - 4 CP, Fundamentals of Artificial Intelligence - 4 CP, Cyber Security and Data Protection - 4 CP, Computer Vision and Image Processing - 4 CP, Critical Thinking and Innovation - 4 CP, Robotics and Autonomous Systems Design - 4 CP, SAF Circuit Design - 4 CP, Embedded Systems - 4 CP, and others).

The content of the programme complies with the ACM/IEEE Computer Engineering Curriculum CEC 2016.

Analyzing the academic and professional Bachelor degree programmes in the field of Electronics and Automation, Electrical Engineering, Information and Communication Technologies, Robotics with a study duration of at least 160 CP at the leading universities of Latvia, the Baltic States and Europe, the faculty management came to the conclusion that programmes with different course titles, necessarily include study courses covering the areas of "Artificial Intelligence", "Automated, Robotic and Autonomous Systems", "Electronic Embedded Systems" and "Digital Communication Technologies" in sufficient volume.

At the same time, Bachelor programmes of other related engineering and other fields, especially those with a duration of 120 CP, usually do not contain such disciplines. Since these areas of knowledge are basic for studying at the Master's study programme “Computer Engineering and Electronics”, a levelling 0th semester is provided for graduates of such programmes, which supplements this knowledge in an amount sufficient to study special subjects "Cyber Security and Data Protection (1 semester), "Digital Signal Processing Algorithms and Systems ", " SAF Circuit Design ", " Advanced Artificial Intelligence " and " Computer Vision and Image Processing " (2nd semester), as well as the completion of the Master thesis (3rd semester) and achieving learning outcomes on a par with students who have a basic Bachelor of Engineering degree in Electronics and Automation with a duration of 160 CP.

The option of a short Master programme (1.5 years) for students with a Bachelor degree (4 years) does not contradict the general European requirements for a Master degree (5-6 years), as well as a long option (2 years) for graduates of a 3-year Bachelor programme. The study courses included in the 60 CP Master programme allow the achievement of the overall learning outcomes achievable within the educational programme (see the attached map), which will lead to a Master's degree in Electronics and Automation Engineering at the end of the programme.

In accordance with Article 56 (7) of the Law on the Higher Education, foreign students learn “Latvian Language for Foreign Students” in the amount of 2 CP. In the higher level programmes, the compulsory study course “Latvian Language for Foreign Students” in the amount of 2 CP is taken by foreign students at the expense of free choice (Block C) courses. For such students, the Block C within the programme is reduced, in the programme “Computer Engineering and Electronics" it is 4 CP, but accordingly the amount of the mandatory part of the programme is increased by 2 CP, i.e. 28 KP.

In accordance with the requirements of the “Law on Environmental Protection” and the “Law on Civil Protection and Disaster Management”, if the previously acquired education has not covered the requirements set out in the “Law on Civil Protection and Disaster Management”, students additionally learn the mandatory (Block A) study course “Labour Protection, Civil Protection and Environmental Protection” in the amount of 2 CP (Article 4.8 of TTI Admission Regulations).

The basis for the quality assurance of the study programme is the cooperation with the potential employers by organising meetings and discussing the issues related to the current labour market trends, labour market demand, listening to suggestions at the Study Field Council, reviewing the annual self-assessment reports of the programmes. The relevance of the course of study is also ensured by the proportion of the academic staff recruited from the industry.

The content of study courses is regularly updated according to the development trends of the industry, labour market and science. The continuous relevance of the study programme is ensured to a large extent by the vision of the programme faculty - professionals and experts in the field - of the development trends in Electronics, Automation, Robotics and the ICT in their respective course topics. This is significantly facilitated by the active practical, scientific and research activities of the programme lecturers - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities.

Study courses, including the contents of the course descriptions, are reviewed annually during the study programme and study direction self-assessment procedure, held in December and January in accordance with the course management regulations. As a result of such self-assessment, a programme development plan is drawn up, which comprises various aspects of the study course including updating of course descriptions following the specific field, labour market and science development trends. There taken into account the feedback from the students in the study course evaluation questionnaires and the opinion of graduates and employers, providing input on the latest developments and current trends in the labour market. The updated courses are coordinated, approved and included in the study programme register and published in the e-learning environment Moodle by the beginning of the new academic year.

The assessment of the relationship between the aims and the achievable outcomes of the study programme and the aims and outcomes of the study courses shows that the content of the study programme and the study courses allows the achievement of the overall aims and outcomes of the study programme. The content of the study courses included in the programme is up-to-date and relevant to the needs of the industry, the labour market and the scientific trends. By successfully completing the programme, the students achieve the expected results of the programme and acquire knowledge, skills and competences that are in high demand in the labour market. The content of the programme courses ensures the continuity for studies in the higher level programmes.

3.2.2. In the case of master’s and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

In the implementation and development of the study program, a direct connection with scientific trends is ensured (see more in criteria 2.4.1 - 2.4.5 of the description of the study field)

The Master programme closely follows the development trends of the industry. The ideas for improving the study process are provided by the employers and professional organisations during the seminars, conferences, round tables or personal contacts of the academic staff, addressing a range of questions about the students' competences, as well as solving the issues related to the students' employment opportunities in the modern labour market. Therefore, the content of the study courses is developed in a sequential manner, in line with the development trends of the industry. The industry experts and guest lecturers involved in the study process also make an important contribution to the education of the Master students by providing feedback on the need to improve the study process and by pointing out the relevant aspects of the business environment. Therefore, the students have the opportunity to acquire the practical skills that will be needed in the labour market.

Knowledgeable and competent faculty members who work in both industry and science, such as Jelena Kijonoka, who works at Accenture Baltics and teaches the course "Artificial Intelligence" in the programme, visiting professor Korhan Cengiz, PhD, who is a member of IEEE and ACM and teaches the course "Algorithms and Systems for Digital Signal Processing", as well as other lecturers who are actively involved in projects and active in research: Irina Jackiva, Dmitrij Pavlyuk, Igors Kabaškins, Aleksandrs Grakovskis, Aleksandrs Kraiņukovs and others.

The content of the study programme is designed in such a way that the emphasis is placed on the applied research in each study course. The aim of the study programme is to provide students with knowledge and practical experience of the latest possibilities of using information and Internet technologies for solving business problems in order to promote business competitiveness and development. At the same time, the content of several study courses included in the programme is based on the current standards. For example, the study course "Project and Requirements Management" uses the PMP standard, the study course "Cyber Security and Data Protection" is based on the GDPR (Regulation (EU) 2016/679) and IEC 62443 standards. All study courses use the modern software that allows students to get an idea of modern technologies, for example, in the study course "Intelligent Data Processing" students use SPSS or STATISTICS software, in the study course "Algorithms and Systems for Digital Signal Processing" – the Matlab software, in the study course "SAF Circuit Design" – the "AWR Design Environment" software.

The scientific and research activities of the academic staff make a significant contribution to the development of the study programme and the improvement of the study content. Lecturers participate in the local and international scientific conferences and seminars, publish research results in scientific publications, develop teaching aids. Through the research, the lecturers bring the most up-to-date innovations and scientific trends in the field into their study courses, including the new study courses or topics in the study programme, for example, the purpose of the study course "Artificial Intelligence" is to provide knowledge on artificial intelligence solutions in Robotics, Embedded Systems and Telecommunication Industry, etc.

In general, the content of the Master study programme "Computer Engineering and Electronics" is updated in accordance with the development trends of the industry, labour market and scientific development, providing the opportunities to acquire in-depth knowledge in Electronics, Robotics, Information Communication Technologies, as well as the use of these technologies in different contexts, thus ensuring the interdisciplinary approach that is so necessary nowadays.

The study programme for the Master degree in Engineering is based on the advances and insights of the Electronics and Automation technology industry. The degree is awarded for a Master thesis, independently prepared and publicly defended under the supervision of an experienced researcher, which contains the results of the original scientific research and provides new insights into the relevant field of science. As part of each Master thesis, students carry out the quantitative or qualitative research, justifying the novelty of the research and contributing to the development of science.

In general, the study programme provides the acquisition of modern theoretical concepts, research methodology and methods in the field of electronics and automation, as well as information and communication technologies, and provides acquisition of skills in the training of industry research and design specialists.

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study process is mainly implemented in the format of interactive lectures, seminars, workshops and student independent work. Courses include workshops, often discussions, role-plays, teamwork, project work, in-basket professional tasks or solving specific practical problems. The choice of a method depends on the learning outcomes that a lecturer is planning to achieve. The applied methods are geared to the development of the students' abilities, specifically, to learning, creative use of knowledge, cooperation, self-evaluation, offering of alternative solutions to problems, to critical thinking and making responsible decisions.

The programme is taught full-time, part-time (organised on Saturdays) and part-time distance learning

The basic principles and procedure for the assessment of the acquisition of the study program comply with the requirements of Article 40 of the National Academic Education Standard. Pursuant to the regulations adopted by the TTI Senate, the results of the academic Bachelor's study program are evaluated according to two evaluation criteria: a quality criterion based on the 10-point marking system and a quantitative criterion - a credit point based on the total number of hours in the course.

The complex method is used to assess the results of study courses. It includes assessment of students' practical work, individual or group work, mid-term assessment and final examinations (a test or exam). In order to facilitate students' independent work, it is stipulated that the final assessment (a test or exam) should not exceed 50% of the final mark for the course. In the beginning of a semester, students are informed about the components of the final mark and their assessment.

In practice, the evaluation process takes place regularly throughout the course of studies. The final assessment of students' learning outcomes is completed at the end of a semester after all stages of assessment are completed, such as practical assignments, seminars, independent work, mid-term assessment and examination. Teaching staff develop an assessment methodology, which indicates the percentage of each assessment criterion in the composition of the total mark.

Students' independent study plays an important role. The description of their progress and how this takes place is included in the study course description as a compulsory part. Students' ability to study independently is purposefully developed in all study courses. The students acquire research skills by working regularly with literature and the Internet resources in order to perform successfully the various independent assignments and the Master thesis. This work promotes students' scientific research activity and work with international scientific databases available at the TTI library.

Independent work (home assignment) is included in almost all Master courses. It is necessary for the successful acquisition of knowledge and skills. The development of independent work enables students to work independently with the offered scientific literature and to apply the knowledge acquired in lectures in practice. In the basic study courses of the programme, the student prepares a presentation according to the topic of the chosen research work, which is publicly defended during the examination.

At the end of the Master studies the student chooses a topic of interest and, in cooperation with a supervisor of his/her choice, develops and defends the Master thesis.

The study methods used in the study programme contribute to the achievement of the course and programme goals and learning outcomes, provide student - centred education to encourage students to take an active part in the learning process and to ensure the appropriate assessment of students' performance.

The principles of student - centred education and an individual approach to students are provided in the study programme:

- Learning outcomes. The evaluations of the study courses of the programme and the number of credit points are related to the learning outcomes. Students are informed about the results of each study course. The lecturers relate the results of the course to the results of the study programme, and also argue the necessity of studying the specific courses in order to become a computer science specialist in software engineering or artificial intelligence;
- Students are involved in the improvement of the content of the study programmes and study process through the students' surveys, as well as through involvement in the collegiate bodies of TTI and the Student Self-Government. Therefore, the students are provided with the opportunity to influence their own study process. Student representation in collegiate bodies is discussed in criterion 1.2 of the study field, the results of the student survey are shown in Appendix 7.
- Access to education and personalization of studies. When students study in the programme, a flexible study process is provided - various forms of study (on-site full time, part time, distance learning), the opportunity to create an individual study plan, which gives students the opportunity to combine work with studies already from the second year. Also, students of the day department have the opportunity to change the form of studying to part-time studies or distance learning in order to combine studies and work. Access to education is ensured by a digitized study process (e-library), discounts, social support (for foreign students, students who come to the university as part of mobility).
- Development of academic staff competencies. Pedagogical methods, study course structure and evaluation methods are chosen by the teaching staff responsible for the study course, according to the specification of the course content and programme, as well as the needs of the students. Courses and seminars on the latest teaching and pedagogical methods are organised for academic staff, as well as the attendance of qualification improvement courses is encouraged, both at internal faculty events, at the level of TTI, and internationally. More details are in the description of criterion 2.3.6 of the study field.
- Students receive feedback, which usually provides advice on the learning process and on

ways to improve their learning and research skills.
- In the organization of research work (in the selection of topics of study projects and final theses), the field of interest of the students, the specificity of the practical work and experience are respected.
- Assessment is consistent, applied equally to all students and is carried out in accordance with the approved procedures, and learning outcomes are assessed in accordance with the Regulations on the Charter of Studies. The assessment criteria for each course of study must be communicated to the students by the teaching staff in the first lecture, and they are published in the TTI e-study environment. The description of each course specifies the connection of the study course evaluation criteria and methods with the learning outcomes of the study course, as well as specified conditions for taking exams. (See Appendix 5.5, descriptions of the study courses of the study programme “Computer Engineering and Electronics”)
- Procedures for examining the student appeals are in place and have been communicated to the students.
- Admission procedures and criteria are open. Admission rules with a detailed description of each programme are published on the TTI website in Latvian and in English.
- An information system has been created to ensure that the students can progress in their studies. More details are available in the description of criterion 2.3.4 of the study field.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The Master studies culminate with the preparation and defence of the Master thesis, which is a complete scientific and applied study that necessarily contains elements of scientific novelty or innovative solutions and recommendations for application. In the period from 2013 to 2022, 19 Master theses were successfully defended in the Master study programme “Computer Engineering and Electronics” (former name is “Master of Engineering in Electronics”).

The topic of the Master thesis is chosen by the student independently from the list of the research directions offered by the faculty for the Master thesis development. The offered topics are broad and comprehensive. The student can make adjustments and clarify the topic together with the supervisor of the Master thesis. The student may also propose the topic of his/her own research. This is usually the case when the student is already working and the chosen research topic will help him/her to acquire better the professional competences in a particular field of knowledge.

The list of possible research areas proposed by the faculty is updated every year, taking into account the development trends in the ICT and global trends in the economy, politics and society, which affect the needs of the labour market and under the influence of which the new requirements for the education of modern IT specialists are formed.

The topics of master theses are often formulated in the interest of companies and in agreement with the company representatives, for example:

- Aircraft Take-off Parameter Analysis Using Video Surveillance Data with the Objective of Organizing an Airport Queue (2013)
- Reduction of Volume of the Transmitted Data at the Round-the-clock Vital Sing Monitoring Outside Stationary Care (2013)
- Research and Development of the Mobile System for Automatic Weighing-in-Motion of the Train (2014)
- X-Ray and Gamma Spectrometer Tuning Using Genetic Algorithm (2016)
- Research of the Efficiency of Transfer Power to the Vehicle by Resonant Induction Method (2017)
- Path Planning for mobile Robot Koala 2.5 using Fuzzy Logic (2020)

In some cases, which is highly appreciated, students were participants in the research projects and chose their research subject according to the project topic:

- Enhancing the Efficiency of Wireless Power Transmission to the Vehicle (2014)
- Increasing Weight Measurement Accuracy of Vehicle in Motion with the Help of Fiber Sensors Calibration Based on Genetic Algorithm (2015)
- Human Skin Usability as Data Transmission Medium (2019)

In the process of defence Master students usually end their presentation with a demo version of the software tool they have developed or a full-size working prototype of an electronic device.

The evaluations of the Master theses are different, but it indicates not only the level of knowledge, but also the ability to concentrate in front of an audience, to argue, motivate and defend one’s opinions and proposals.

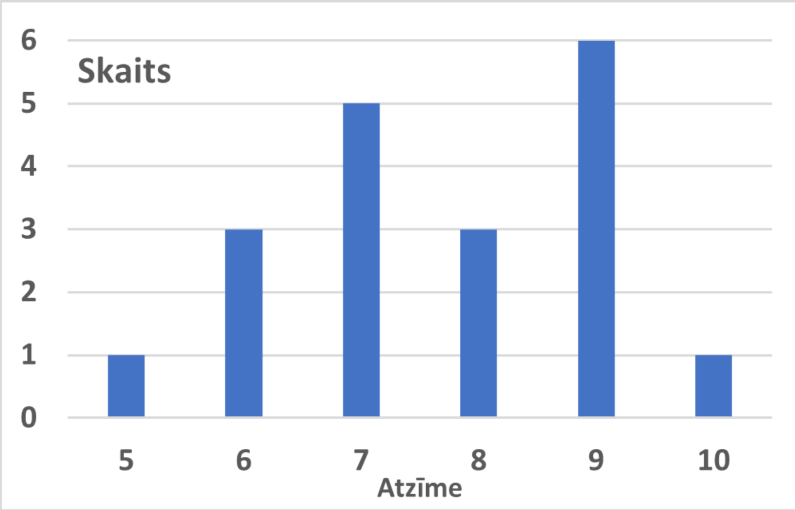


Figure 1. Master thesis evaluations during the reporting period

As can be seen from the evaluations of the Master thesis in the reporting period (see Fig.1), most of the final theses were evaluated in the range from 7 (good) to 9 (excellent), which accounts for 79% of all defended Master theses, of which 6 were evaluated as “excellent”, 3 as “very good”, and 5 as “good”. 16% of students received the grade 6 (almost good), and 5% of students received the grade 5 (satisfactory). The highest mark “excellent” is awarded only for outstanding performance, and if the student has presented at an international or national conference, prepared a scientific publication, etc. Such an assessment was awarded only once during the reporting period. The positive evaluations of Master theses reflect the high scientific quality of Master theses, the ability to defend the research results convincingly and argumentatively, as well as the graduates' preparedness and suitability for the labour market.

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

In the study direction report Part II, Chapter 3, Criteria 3.1-3.3 full information on these issues is provided. In this paragraph there is only additional, separately highlighted and emphasised additional information on the study programme.

The study process is mainly provided by the staff of the Faculty of Engineering of TTI. In addition to that, the staff of the Faculty of Transport and Management Sciences are involved in the humanities and social studies courses

The Faculty of Engineering of TTI provides academic and methodological work: creates and updates the study course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and defends the final examination papers and carries out other activities related to teaching, methodological and scientific work.

The laboratories of TTI are used intensively during the study period in order to provide students with practical experience. The implementation of a modern Master degree programme in electronics, automation, telecommunications and robotics is not possible without a wide range of educational and research laboratory facilities.

All special subjects of the programme contain practical laboratory or research tasks carried out in the laboratories of the Telecommunications, Electronics, Robotics Centre (TERC). List of the courses and laboratories used in the "Computer Engineering and Electronics programme" is as follows:

- Cybersecurity and Data Protection - CISCO Computer Networks Laboratory;
- Design of Robotics and Autonomous Systems - TERC, Robotics Laboratory;
- Computer Vision and Image Processing - TERC, ABC&IP Laboratory;
- Algorithms and Systems for the Digital Signal Processing - TERC, Microcontroller Laboratory;
- SAF circuit design - TERC, Electronics Laboratory;
- Embedded Systems - TERC, Microcontroller Laboratory.

All laboratories are equipped with modern electronic equipment and digital measuring devices, which are extremely important for learning the subjects of the programme. For example, in the course "Digital Signal Processing Algorithms and Systems" students choose the research topic in their field of interest, which is usually related to a future Master thesis topic, develop an idea for an experiment, plan the stages and choose the necessary laboratory equipment, assemble a measurement bench, carry out measurements and interpret the obtained resulting data.

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the programme's inception, tuition fee income has been the main source of funding for the study process. The programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee per full-time student is EUR 2400 per year, per part-time student - EUR 1920 per year, distance learning - EUR 1700 per year. The amount of tuition fees for each academic year shall be determined and approved by an order of the Rector.

The tuition fee payment procedure is laid down in the Regulation of the tuition fee payment procedure, which provides the possibility to pay tuition fees for the whole study programme, for one academic year, for one academic semester or as a monthly payment (starting from the 2nd semester).

Average costs is showed in Annex 5.7. There is no difference in the cost of studies in Latvian and English, as the studies are provided at a high quality level without a breakdown by language of study, and therefore no difference in tuition fees.

The cost structure of the study programme in the last academic year 2021/2022 includes salaries and taxes (including costs of scientific publications, etc.). (including fees for teaching staff in accordance with the TSI Teaching Staff Remuneration Regulations) 55%, study programme development and implementation costs 5%, teaching materials and other similar costs 9%, scientific infrastructure costs and other similar costs 14%, advertising and marketing costs 2% , infrastructure costs (including IT costs) 6%, depreciation and amortisation 7%, other administrative costs 2% .

Each year, TSI provides students with the opportunity to receive personalised discounts of 50%, 75% and 100% on full-time tuition fees, which are awarded on a competitive basis. Applicants are evaluated according to the results of the national centralized exams, the average score of the certificate, motivation and other additional achievements.

In order for the programme to be cost-effective, there must be at least 6 students in the programme. It is taken into account that the sequence of study courses is respected in the Master programmes of the study field, as well as the study plans of each programme are mutually coordinated with each other - the study courses included in the plan and their sequence by semesters.

These are the study courses that develop research skills and critical thinking: Critical Thinking and Innovation 4 CP and Research Methodology 6 CP, or the study courses Artificial Intelligence 4 CP and Advanced Artificial Intelligence 4 CP, which are included in the 2nd and 3rd semesters of the programmes respectively, and provide knowledge and skills in the organisation of intelligent systems, methods of applying artificial neural networks and genetic algorithms, expert observation methods, etc., and are implemented together with the students of the Master programme “Computer Science”.

6 students is indicated as an average number, since as it has already been mentioned, several courses are taught jointly for different programmes. The costs for the full-time in-person study programme in the amout of the 80 CP are higher, therefore, more students are required for this programme - 7 people, part-time face-to-face - 5 people. The language of study does not affect the amount of costs.

Therefore, the funds are saved the programmes become cost-effective even with fewer students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and

the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The teaching of the study programme is provided by 13 members of academic staff with relevant academic experience and qualifications, and 10 of them are elected lecturers.

4 TTI professors and 2 associate professors with the Doctoral degrees in Engineering are involved in the implementation of the compulsory and limited optional parts of the Academic Master programme “Computer Engineering and Electronics”: Dr.sc.ing. A.Grakovskis, Dr.sc.ing. I.Jackiva, Dr.sc.ing., D.Pavlyuk and Dr.hab.sc.ing I.Kabaškins, as well as associate professors Dr.sc.ing. N.Spiridovska and A.Kraiņukovs. Therefore, it can be concluded that the qualifications of the academic staff involved in the implementation of the study programme fully comply with Paragraph 55 part 1 of the Law of the Republic of Latvia “Law on Higher Education”, which stipulates that not less than five professors and associate professors together who have been elected to academic positions at the respective higher education institution participate in the implementation of the compulsory and limited optional part of the academic study programme.

In addition to the above-mentioned professors, the programme is implemented by 3 assistant professors and 1 lecturer, all of whom are not only lecturers elected at TTI, but also work in companies in the industry and are experts in their field: J. Revzina, iPro Ltd. cyber security engineer and Cisco Networking Academy instructor; J.Kijonoka, Accenture Latvia data scientist; S.Šarkovskis, Sonarworks Ltd., DSP Researcher; I.Radčenko was LATVENERGO TEC-1 Network Administrator for more than 20 years.

A total of 90% of the academic staff involved in the programme have Doctoral Degrees in Engineering.

The study process involves a number of other specialists in the field, whose professional experience not only deepens the students’ practical knowledge and skills within the study course, but also enhances the students’ employment opportunities after graduating from the programme. For example, the graduate of the same programme, M.Belihin, a specialist of the telecommunication service of “Latvian Air Traffic” (LGS), teaches the study course “Algorithms and Systems for the Digital Signal Processing”. In 2021-2022 this course was lectured by Prof. Korhan Cengiz (PhD) from Turkey.

2 of the guest lecturers have a scientific Doctoral degree, the others have Master degrees.

Some courses have several lecturers, or the main course is taught by the programme director, but it is already expected that that the representatives of the industry will be invited as guest lecturers for some topics, thus ensuring both the quality and relevance of the study course content.

In order to improve the quality of the programme, the lecturers deliver courses in one of the two languages only. Lecturers carry out scientific research and participate in the education of students. The Institute of Transport and Telecommunications ensures the professional development of its staff as far as possible and provides incentives with a remuneration, which is competitive in Latvia.

Foreign teaching staff: Neil Rubens (Big Data) teaches in English only in the study programmes for both students studying the programme in English and for students studying the programme in Latvian, taking into account that the university has the right to implement no more than one fifth of the study programme credits in a foreign (Article 56, paragraph three of the Law on Higher Education, paragraph 5.1.2 of the TTI study contract).

The knowledge of the state language by the academic staff involved in the programme complies with the Cabinet of Ministers' Regulation No. 733 of 07.07.2008 “Regulations on the scope of knowledge of the state language and the procedure for testing state language proficiency for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union, and the state fee for testing the knowledge of the state language”. The TTI Human Resources Department verifies the skills in the state language at the time of recruitment.

In order to ensure the English language proficiency of the academic staff, TTI periodically organises English language proficiency tests and, if necessary, additional training, e.g. in the academic year 2019/2020, several of the academic staff improved their English language proficiency in the courses organised within the project 8.2.2. and repeated English language courses are planned in the future from the university own funding.

The qualifications of the teaching staff involved in the implementation of the study programme meet the conditions for the implementation of the study programme and the requirements of the regulatory enactments, ensure the achievement of the goals and study outcomes of the study programme and the corresponding study courses.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In the period since the previous accreditation in the academic year 2012/2013, changes have occurred in the composition of the academic staff involved in the implementation of the Master programme “Computer Engineering and Electronics”.

Position	2012 /2013 academic year			2021 /2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professors	4		4	4		4
Associate Professors	1		1	2		2
Assistant Professor	4		4	3		3
Lecturers		1	1		1	1
Guest lecturers	2		2	1	2	3
Total			12			13

The total number of lecturers is almost unchanged, but only 4 members of the academic staff continue to teach in the programme from the last accreditation. During the reporting period, 7 new lecturers (elected by TTI) were recruited to the programme to teach a specific course or a part of it. Only one of them does not hold a Doctoral degree.

Changes in the composition of lecturers are influenced by several factors. One of them is the generational changes, since many lecturers were in the pre-retirement age group at the time of the previous accreditation. There are now many younger lecturers (under 45 years of age). A number of faculty members have upgraded their academic experience and have been elected to senior positions. J.Kijonoka, who was a lecturer in 2012, obtained her Doctoral degree in 2015 and was elected as an associate professor, and at the same time she works at Accenture Latvia.

During the reporting period, a number of lecturers of TTI obtained the Doctoral degrees and are currently lecturing in the programme as professors or associate professors: D.Pavlyuk, N.Spiridovska.

The choice of lecturers is determined by the content of the study programme, which is continuously improved according to the rapid development of the ICT industry. The programme includes the study courses that provide future competences, and for teaching these courses the following faculty members specialising in the particular field are invited, including from the professional environment: J. Revzina, S. Sharkovskis, V. Gredasovs.

This makes it possible to ensure the connection of the programme with practical activities, since the information is obtained directly from the industry professionals, and generates more interest among students.

During the reporting period, the University made a concerted effort focused on the composition of the academic staff in order to ensure the quality of the study programmes in the best way. The human resources development plan of the faculty was elaborated, which provides for the improvement of the quality of study programmes by promoting the growth of the existing academic staff, attracting academic staff recognized in the academic environment, experts and professionals in the field, foreign guest lecturers, as well as students and graduates of the doctoral study programme of the university.

In general, it can be concluded that the changes in the structure of the academic staff involved in the study programme can be evaluated positively, that the relevant qualifications and experience of the academic staff in academic work ensure a high quality of education and that it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for mutual cooperation between academic staff, which promotes the development and interconnection of the study courses. The improvement of the study courses is carried out on a regular basis, based on suggestions made by students, industry development trends, and the latest results ofthe research, scientific activities and innovations.

During the implementation of the study courses and scientific work, regular meetings of teaching staff take place, in which they exchange experience on the study course topics, results of scientific work, new developments in the research, etc. Discussions are used to develop and improve the content of studies, with mutual agreement on topics, emphases, responsibilities and compliance with regulatory requirements. The leading lecturer of the study course "Research Methodology" is Professor I. Jackiva. The course is divided into two parts, the first one is dedicated to the development of general research skills, and the second one – to an in-depth study of different research approaches and methodologies in order to prepare the students for the development of the final thesis in the relevant field of study. The course is taught in all Master level programmes and, accordingly, the directors of all Masters Programmes were involved in its development. The first two topics of the course, which deal with the basic stages of the research and the use of a systems approach, interdisciplinary in research, the main directions of the research in Europe and Latvia, etc., are taught by TTI Professor Igors Kabašhkins. In the last class of the first part of the course, which is also attended by the programme directors, the students discuss and publicly debate the objectives of their proposed research. The second part of the course is taught by the director of the corresponding programme.

In order to ensure the effective implementation of the study programme, the Director of the study programme engages the senior lecturers in an open discussion on the content of the study programme, study outcomes, and implementation approaches. Academic freedom is respected; any interested faculty member may participate in the discussions. This principle is followed in situations where a course of study belongs to another faculty, but the programme director has suggestions concerning the course of study. The discussions take place in an informal setting and aim at discussing and agreeing on the above aspects of the implementation of the study programme, as well as discussing the content of specific courses in order to avoid duplication of topics in the course content, and discussing the teaching methods used in the course.

Following the discussion, the programme director shall make proposals to be included in the annual self-evaluation of the programme. If a new course of study is proposed to be included in the programme, the discussion takes place during a formal meeting of the faculty: the need for the new course is discussed, the learning outcomes of the course are defined, and the lead teaching staff member responsible for the preparation of the course description and methodological material is identified. An expert is identified who will review the material and make recommendations to the lead lecturer.

The connection with employers is also strengthened through the active participation of teaching staff in professional organizations and associations, the most important of which are the Latvian Information and Communication Technology Association (LIKTA), the Latvian Electrical Engineering and Electronics Industry Association (LETERA), the Mechanical Engineering and Metalworking Industry Association (MASOC)), Remotely Piloted Aircraft Association (LARPAS), Simulation Modeling Society, European Conference of Transport Research Institutes (ECTRI), Informatics Europe, etc.

As part of the study process, the preliminary defences are organised with the participation of a committee of faculty members, where the recommendations are collectively made to improve the master theses. Consequently, mutual cooperation between lecturers of different fields is ensured and allows comprehensive recommendations for the development of Master's theses. The same cooperation is observed after the defence of the master theses, when the Final Examination Board gives its evaluation as a result of the discussion, based on the evaluations proposed by the members of the Board. The committee is composed of leading faculty members, and the chair of the committee is a company representative.

Experienced researchers working at the Faculty of Engineering participate in the research projects and activities funded by the Latvian Council of Sciences, the European Commission and other international funding sources and foundations in cooperation with partners in universities and research institutions in Latvia, European Union Member States and worldwide: I.Kabashkin, I.Jackiva, D.Pavlyuk, A.Grakovskis.

The total number of teaching staff involved in the implementation of the programme is 13, but the total number of students in full/part-time studies in 2021/2022 was 7, thus the ratio of students to lecturers is 0,5

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annex 5.6. Diplom CEE.zip	5.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	Annex 5.8 Opinion of the Council of Higher Education.docx	5.8.pielikums. AIP apliecinājums Mg datoru inženierija_250.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 5.1.Statistics on the students.pdf	5.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 5.2. Compliance with the State Education Standard.docx	5.2.pielikums. Atbilstiba akademiskajam standartam 3001.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 5.3. Mapping of the study courses.xlsx	5.3.pielikums. Studiju kursu kartejums_MSc_CEE.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 5.4. The curriculum of the study programme.zip	5.4.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 5.5. Descriptions of the study courses modules.zip	5.5.pielikums. Studiju kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 5.9 Confirmation.docx	5.9.pielikums. Apliecinajums atbilstiba AL.pdf

Computer Science (43483)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Computer Science*
Education classification code	*43483*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Boriss*
Surname of the study programme director	*Mišņevs*
E-mail of the study programme director	*Misnevs.B@tsi.lv*
Title of the study programme director	*Dr.sc.ing.*
Phone of the study programme director	*26464212*
Goal of the study programme	*The aim of the programme is to prepare professionals with professional knowledge and skills in computer science at international level, software engineering and artificial intelligence, as well as the ability to participate in computer system development projects in a variety of roles (including management) and to comply with professional ethics and IT standards; to prepare students for further studies at Master's level.*
Tasks of the study programme	*• computer science, computer systems and information technologies for solving a wide range of practical problems in today's society; • to teach the skillful and effective use of intelligent technologies, both in solving various tasks and in developing automation and adaptive computing systems; • teach how to solve technical, organizational and social problems in certain conditions at the level of ICT projects; • to train to critically analyse and apply relevant concepts, principles and practices of computer science in the context of loosely defined scenarios, using organisational skills and time management, both individually and as a member of a team; • to provide insight and knowledge into the organisation and social issues of scientific work, as well as the fundamentals of economic activity and innovation; • to prepare students for the further studies in the professional programmes of higher level and Master programmes, scientific activities and further self-education.*

Results of the study programme	*1. demonstrates basic knowledge and critical understanding of the field of computer science in general and of computer systems according to specialization: software engineering or artificial intelligence 2. is able to extract, analyse and use information to formulate, explain and competently discuss the approaches in solving the problems. 3. demonstrates knowledge and understanding of IT regulations and standards 4. is able to participate in the development and management of software computer systems projects 5. is able to design and develop data analytics, machine learning and artificial intelligence solutions to solve the problems of the real world. 6. is able to demonstrate organisational and time management skills, working individually or in a team, and is able to organise and manage communication in a professional environment, respecting the principles of professional and general ethics. 7. is able to plan independently the own learning process, to manage the own and the subordinates' further learning and professional development in the digital environment. 8. is able to apply a scientific approach to solving the problems in computer systems, to take responsibility and initiative, to make decisions and find creative solutions.*
Final examination upon the completion of the study programme	*Bachelor's Thesis*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*

Amount (CP)	*160*
Admission requirements (in English)	*Secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia, except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*english*
Amount (CP)	*160*

Admission requirements (in English)	*Secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia, except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies distance education - 5 years - english

Study type and form	*Part time extramural studies distance education*
Duration in full years	*5*
Duration in month	*0*
Language	*english*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education Studijām angļu valodā nepieciešams uzrādīt CE sertifikātu angļu valodā, vai vērtējumu angļu valodā iepriekšējās izglītības dokumentā, vai starptautiski atzītas testēšanas institūcijas pārbaudījuma vērtējumu vismaz B2 līmenī vai TSI iestājpārbaudījuma angļu valodā vērtējumu (tikai Latvijā ieguvušiem izglītību), izņemot gadījumus, kad iepriekšējā izglītība iegūta angļu valodā. Ārvalstu reflektantiem jākārto iestājpārbaudījums matemātikā .*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies distance education - 5 years - latvian

Study type and form	*Part time extramural studies distance education*
Duration in full years	*5*
Duration in month	*0*

Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Natural Science in Computer Systems*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

No.	Parameter	Changes made in the period since the previous accreditation	Changes made in the process of accreditation
1.	Field of Study	---	---
2.	Name of the study programme		Changed from “Bachelor of Natural Science in Computer Science” to “Computer Science”, a name that is widely used in the international environment and more accurately describes the content of the programme, as well as following the expert recommendations – the programme name should not duplicate the degree to be awarded.

3.	The code of the study programme in accordance with the Latvian Classification of Education	According to the decision of the Study Accreditation Commission of October 13, 2022, changed from 43481 to 43483, in accordance with paragraph 5.2 of the Cabinet of Ministers Regulation No. 322 “Regulations on the Latvian Classification of Education”.	
4.	Type and level of the study programme		---
5.	Amount of the study programme (KP)		---
6.	Form, type, duration of programme implementation	By the decision of the Study Accreditation Commission No. 371 of June 3, 2015, the form of the study – distance learning – was added to the programme	---

7.	Language of instruction		Latvian and English The programme was previously also accredited with Russian as a language of instruction, the last students studying in Russian will graduate from the programme in June 2023. *Article 49 of the Transitional Regulations of the Law on Higher Education, according to which it is prohibited to enrol students for studies in Russian after January 1, 2019.*
8.	Place of implementation		Place of implementation is Riga. The programme was previously accredited with an implementation site in Riga and the Latgale branch of the TTI in Daugavpils. *In spring 2022, the Latgale branch of TTI was closed and excluded from the Register of Higher Education Institutions.*
9.	Director of the study programme	----	---
10.	Uzņemšanas prasības Admission requirements	According to the Council of Higher Education Decision No 1.10/28 of November 15, 2018 it was agreed on additional admission requirements for foreign applicants: tests in English and Mathematics	---

11.	Awarded degree	With the decision of the Study Accreditation Commission of October 13, 2022, changed from “Bachelor of Natural Science in Computer Science” to “Bachelor of Natural Science in Computer Systems, Databases and Computer Networks”, specifying it in accordance with the Cabinet of Ministers Regulation No. 322 “Regulations on the Classification of Latvian Education” for the group of programmes with code 483 The changes were made in accordance with the Cabinet of Ministers Regulation No. 793 of December 11, 2018 “Regulations on Opening and Accreditation of the Study Directions “ to Section 2.2 as technical changes on the accreditation sheet of the study direction.	Changed to “Bachelor of Science in Computer Systems” in line with the aim and content of the programme.

12.	The goal of the study programme		Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.
13.	Tasks of the study programme		Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.
14.	Learning outcomes		Learning outcomes have been refined in line with the goal of the programme, updated study course outcomes and European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) requirements for level 6, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.
15.	Final test		---

Changes in the name of the programme

The programme was licensed more than 20 years ago with a name that duplicates the academic degree awarded in the programme. This creates inconvenience both for the university and for applicants and students, since such a long name duplicating a degree is not very memorable. From the moment the programmes were licensed in TTI, several programmes in different fields of study retained similar titles, duplicating the degree to be awarded. Experts and the Study Accreditation Commission have repeatedly pointed out the need to change the names of the programmes at TTI, for example, in 2021, when approving changes to the TTI programme “Master of Social Sciences in Transport and Logistics”.

Therefore, the name of the programme “Bachelor of Natural Sciences in Computer Science” is changed to “Computer Science”. This is the name used for programmes in this field in the international environment and also for programmes implemented by universities in Latvia.

Changes in the degree awarded and in the education classification code

The degree to be awarded has been changed from “Bachelor of Science in Computer Science”, education classification code 481, to “Bachelor of Natural Science in Computer Systems”, code 483, in accordance with the amendments to the Cabinet of Ministers Regulation No 322 “Regulations on the Classification of Education in Latvia” dated 02.10.2018 and 09.11.2021, which provides for the expiry of code 481.

Due to the fact that the changes in the Regulations of the Cabinet of Ministers, which determine the expiry date of the code, were adopted in November 2021, and the whole process of evaluation and accreditation of the field of the study takes about a year, it was not possible for TTI to change officially the programme code and the degree to be awarded to the preferred one in accordance with the legally established procedures. The change was submitted to the Study Quality Commission (SQC) as a technical change to the accreditation sheet for the field of the study. By Decision of the ISC of 13.10.2022, the programme code was changed to 843, and the degree, according to the thematic group of education, to “Bachelor of Science in Computer Systems, Databases and Computer Networks”, with the verbal justification that when submitting the programme for evaluation, TTI may change the degree to be awarded in the Bachelor programme to the preferred degree.

At the beginning of 2022, the Master’s level programme “Computer Science” at TTI was evaluated and code 483 was assigned. Both Bachelor and Master level programmes are designed according to the principle of logical succession, with the same programme specialisations in software engineering and artificial intelligence. Both programmes with a specialisation in Artificial Intelligence are also taught in a double degree format in collaboration with the University of the West of England (UWE Bristol). The content of the Bachelor and Master programmes ensures the development of the competencies of specialists in the field of various computer systems in the IT industry.

Changes in the structure of the programme

The main changes in the structure of the “Computer Science£ programme are related to the inclusion of two specialisations in the programme: software engineering and artificial intelligence.

The changes in the structure of the programme are related to the current changes in the IT industry and the inclusion of the content of these changes in the study courses. For example, the programme includes new study courses on Cloud Computing and IoT, AI Tools and Methods, Blockchain Technologies, Database Design Concepts, Database Processing, Foundations of Data Science, Quantum Computing and others. Some study courses were added to the programme based on the recommendation of the partner companies, for example, Cloud Services Integration. In order to develop “soft” competences, the course on Academic Skills and Critical Thinking has been added.

Some study courses were replaced since they have lost their relevance in order to be taught at the level of a separate course, for example, Web-Application Development, Electronics and Microelectronics, Embedded Electronic devices and Programming, Web-Application Development Tools. At the same time, the content of these study courses excluded from the programme was either partially included in the topics covered by the new courses or was transferred for study in another study programme.

Following the recommendation of the experts of the previous accreditation, the content of all basic study courses was increased to 4 credit points. The total number of credit points in the programme has not changed, because “increase” does not mean a mechanical increase of credit points; it is about the merging of the study courses for methodological reasons. For example, the previous version of the study programme included two courses: Operating Systems (4 CP) and System Programming (4 CP). These two courses were combined into one Operating Systems and Systems Programming. In this case, the primary reason for the merger was to focus knowledge and skills around the control of operating system resources and their use through code.

The artificial intelligence specialization was also coordinated as a double degree program with a similar program of the British university (UWE Bristol) in terms of the composition of study courses.

A major change in the structure of the programme is related to the strengthening of the project based learning for students. The programme included three individual projects and one group project, which are carried out annually by students of both specialisations. These changes contribute to the development of students’ practical professional competences and improve the interdisciplinary links in the programme.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The name of the Bachelor study programme “Computer Science” indicates that the programme belongs to the field of Information and Communication Technologies and thus logically fits into the study field “Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”. Upon successful completion of the programme, a Bachelor of Science degree in Computer Systems is awarded, which is in accordance with the Cabinet of Ministers Regulation No 322 “Regulations on the Classification of Latvian Education" and also indicates the content of the programme and the program’s affiliation to the thematic area of education Computer Science.

The aim and objectives of the Bachelor’s programme “Computer Science”, as well as the study results obtained during the study, correspond to the sixth level of the Latvian Education Classification (the Cabinet of Ministers Regulation No. 322 “Regulations on the Latvian Education Classification”).

The tasks defined in the study programme are aimed at achieving the programme objective “to prepare specialists of international level with professional knowledge and skills in computer science, software engineering and artificial intelligence, as well as with abilities to participate in computer system development projects, performing the duties of various positions (including the managerial ones) and observing professional ethics and IT standards; to prepare students for further studies at Master's level" and ensuring the study results.

The achievable study outcomes of the study programme are formulated using a student centred approach, defining in a structured and detailed manner the knowledge, skills, competences that the student possesses and which the student is able to use and implement after graduation.

The study programme "Computer Science" is aimed at preparing the computer science specialists with advanced knowledge in the field of software engineering and artificial intelligence. Graduates of the programme can work as analysts or computer systems engineers, application software development engineers, software engineers, website developers, information security specialists, testing engineers, QA engineers, automation solutions architects, automation solutions developers. The content and implementation of the study programme is focused on students' skills in applying the latest IT technologies and developing their competences in line with the demands of the global labour market.

The mapping of the study course (Appendix 2.3) for the achievement of the outcomes of the study programme allowed implementation of an in-depth analysis and specification of the achievable outcomes of individual study courses.

The admission requirements are determined in the TTI Admission Regulations and are based on the following normative acts: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the Cabinet of Ministers Regulation No. 846 of October 10, 2006 "On Requirements, Criteria and Procedures for Admission to Study Programmes". A student who has passed the secondary school leaving certificate, who demonstrates proficiency in the national language and in a foreign language and in Mathematics (e.g. by successfully passing the centralised examinations) is eligible to study in a higher education programme.

The study programme is implemented in Latvian and English. For studies in English, applicants are matriculated on the basis of the results of the CE certificate in English, a test score of at least B2 level from an internationally recognised testing institution or the TTI entrance examination in English (only for those who have completed secondary education in Latvia).

Foreign applicants are matriculated on the basis of the results of an internationally recognised testing institution test in English at least at level B2 or a TTI entrance examination in English at least at level B2, except in cases where the previous education was obtained in English, and an entrance examination in Mathematics.

For studies in the double degree programme, the terms of the agreement concluded with UWE Bristol provide for the admission of students with a secondary school certificate score of 55% in Mathematics and 55% in English.

The amount of study programme implementation is 160 credit points, the duration of implementation in full time studies is 4 years, in part time studies - 5 years, in part-time distance education - 5 years. The study courses included in the programme in the amount of 160 CP allow to achieve the study programme learning outcomes (see Map in Appendix 3.3) and the goal of the programme. The scope of the programme is adequate so that after 4 or 5 years of studies, a computer science specialist with in-depth knowledge in software engineering and artificial intelligence will graduate from the programme.

Such preparation of the applicants in their previous education, motivation to obtain higher education and organisation of the study process, TTI is able to ensure the achievement of the programme learning outcomes and to award the Bachelor of Science degree in Computer Systems upon graduation from the programme.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

Bachelor Study programme “Computer Science” corresponds to the field of smart specialisation “Information and Communication Technologies”. The Ministry of Education and Science believes that the indicated area is an area with a direct horizontal investment in the development of other areas of smart specialisation – Bioeconomy, Biomedicine, Smart Materials and Technologies, Smart Energy, and it plays a significant role in promoting the transformation of the national economy in order to facilitate the growth of high and medium high technologies in Latvian export of goods and services. In the field of Information and Communication Technology specialisation in Latvia, the research and innovation has been developed in the following thematic niches (there indicated only those that correspond to the TTI study programmes and the TTI research pillars): Algorithms, Machine Learning, Business Process Management Systems, Electronics, Smart Sensors and the Internet of Things, Robotics, Big Data, Data Storage, Transmission and Systems. This indicates that the proposed study programme will correspond to the field of smart specialisation.

In the informative report of the Ministry of Economy of the Republic of Latvia on medium and long term forecasts of the labour market, it is stated that “Until 2040, the demand for labour will continue to shift in favour of the demand for specialists with higher education”. There also will be a more pronounced shortage of professionals with vocational training. By 2027 the gap between the labour supply and demand for professionals with a vocational qualification could increase to 37 thousand specialists. The demand and supply of education in Natural Sciences, Mathematics and Information Technologies in 2027 is estimated to be 112% (Balancing of workforce supply and demand EM, only in Latvian): Supply – 31083, Demand – 34919, Shortage – 3836.

The projected labour surplus /shortage and number of graduates in the STEM field (supply and demand gap in 2027, number of graduates in 2019) is 2850 graduates and 14,000 is labour shortage (CSB data for 2019. EM forecasts for 2027, available only in Latvian).

The informative report of the Ministry of Economy of the Republic of Latvia on medium- and long term labour market forecasts states that “With the current structure of the higher education supply remaining, the most significant labour shortages in the higher education group are expected for the specialists with a background in Engineering, Natural Sciences and ICT (STEM) fields. The shortage of the specialists with the proper qualifications could reach 14 000 by 2027, mainly in the areas such as Architecture and Construction, Computer Science, Physical Sciences and Engineering”.

According to CV.LV data (as of 31.05.2022), there are 887 vacancies in the field of Information Technology in Riga only. It includes 40 programmers, 91 analysts, 29 security specialists, etc. At the same time, there are 782 more vacancies in the field of Information Technology in the Riga region.

According to the Education Development Guidelines 2021-2027 “Future skills for future society”, ACTION PLAN 2021-2023, the employment of the higher education graduates (CSB) is planned to be 80% (2024); nevertheless, as it is shown by the monitoring data of graduates of higher education programmes by the Ministry of Education and Science, the employment rate for TTI “Computer

Science” Bachelor programme graduates in 2020 was already 80.5%.

Based on the data from the monitoring tool for graduates of higher education programmes (https://www.viis.gov.lv/monitoringa-riki, (available only in Latvian), the income of 2019 graduates in Computing in 2020 was estimated to be the highest – 22,298 EUR (weighted average income). The income of TTI graduates in Computer Science was estimated to be 27 149 EUR.

Demand for TTI STEM programmes from the part of foreign students is growing every year (on average, of 30% per year), which shows that the existing programmes have export potential (this applies to Bachelor, Master and Doctoral levels study programmes). For the third year a double degree programme has been successfully implemented together with the British University of the West of England, UWE (Bristol).

Looking at the topicality of the study programme, it can be concluded that the programme of the Computer Sciences of TTI fully corresponds to the modern global trends in the field of ICT and Engineering, as well as the most important directions of the development of the national economy of Latvia in accordance with the smart specialisation. The distinctive feature of the Bachelor Degree programme in Computer Science is the presence of two most popular specialisations today – Software Development and Artificial Intelligence. In Latvia the study programmes of the Faculty of Engineering of TTI occupy a certain significant market share (TTI is the only one among the universities implementing STEM programmes that does not have the state budget funding). About 15 universities and colleges, the largest of which are RTU and LU, prepare similar specialists in Computer Science. The level of quality of competences acquired by the graduates of TTI provides them with the opportunity to find jobs not only in Latvia, but also abroad (EU, USA, Germany, UK, etc.). Bachelor of Computer Science programmes are offered by Rezekne University of Technology and Daugavpils University (until 2019). Turiba and RBS also developed the study programmes related to the Information Technology (the latter is organised as a joint programme with a US university). It should be noted here that in 2021 the University of Latvia also opened a double degree programme in Computer Science with a UK university.

In general, it should be concluded that the “Computer Science” study programme meets the needs of both Latvia’s intelligent specialisation and the national economy. The analysis of the development plans economic and social needs of the Republic of Latvia in the age of digitisation clearly indicates the need to continue and expand the training of specialists in the Bachelor degree programme in Computer Science.

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The Bachelor study programme “Computer Science” (former name “Bachelor of Natural Sciences in Computer Science”) is licensed and accredited full time and part time in Latvian, Russian and English, and since 2012 also part-time distance learning.

The graphs in the appendix show a steady upward trend in the number of students in all types, forms and languages of study up to the academic year 2018/2019.

The decrease in the number of students in the academic year 2019 - 2020 is related to the amendments of June 21, 2018 and April 18, 2021 to the Law on Higher Education Institutions of the Republic of Latvia, which stipulates that higher education institutions whose language of instruction at the study programmes does not comply with the conditions of Article 56, paragraph 3 of this Law have the right to continue implementation of study programmes in the respective language until December 31, 2025. After January 1, 2019, the admission of students to the study programmes with the language of instruction, which that does not comply with the provisions of Article 56, paragraph 3 of this Law is not allowed. Therefore, in the academic year 2019-2020, students were no longer enrolled for studies in the Russian language at TTI, which resulted in a decrease in the total number of students and the number of foreign students.

Beforre this moment, the international students have been admitted to study in English and Russian, and many foreigners, mostly from former post-Soviet countries, have taken the opportunity to study in Russian. The academic year 2022 - 2023 is the last year in which the programme will continue to be conducted in Russian. The students have been informed of this, and if for any reason they do not graduate from the programme, they will be offered the opportunity to continue their studies in Latvian or English.

The breakdown of foreign students by country of residence in the academic year 2021 - 2022 is given below

Country	Number of students
· Azerbaijan	2
· Republic of Belarus	2
· Bulgaria	1
· Arab Republic of Egypt	1
· India	8
· Italy	1
· Cameroon	1
· Kazakhstan	6
· Kyrgyzstan	2
· Russian Federation	24
· Pakistan	4
· Tajikistan	1
· Ukraine	4
· Uzbekistan	15

The enrolment results for the academic year 2020/2021 were in turn affected by the restrictions imposed worldwide as a result of the Covid-19 pandemic, especially the number of international students in the programme.

As a private educational institution, TTI provides the study on the basis of tuition fees. Similar computer science programmes are run by the University of Latvia and Riga Technical University, where the state budget study places are available for students. This demonstrates the consistent interest in the TTI study programme and the relevance of the programme, taking into account the impact of the ICT industry on the national economy.

Currently, in recent years, the programme has been graduated by the students who entered when the overall number of students was high.

The drop-out rate is around 25% annually, and it is higher among international students. Statistical data show that students drop out their studies for reasons of failure (it is the main reason for international students), or because they have the tuition fees debt, or in some cases by their own choice. In these situations, the programme leader meets with the student to find out a more precise reason. Often these are private considerations that are not related to the quality of the study programme. Statistical data indicate that it is common for a person not to resume their studies after an academic leave. Since IT professionals are in high demand on the labour market, students who have acquired the basic skills from the second year of study enter the labour market and are often no longer able to combine work and studies afterwards.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

Not relevant

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study program has been developed pursuant to Regulation No. 240 of the Cabinet of Ministers of 13 May 2014 on the National Academic Education Standard, the compliance can be seen in

Appendix 2.2. The study direction and the study programs included in it have been developed taking into account the mutual connection and sequence of study courses. This enables to achieve the goal of the study program and provide a set of knowledge, skills and competences in accordance Level 6 of the European Qualifications Framework of Latvian Education Classification.

In order to ensure the attainment of the aim of the study program, the study program contains nine elements of knowledge, skills and competencies to be acquired. Considering the achievement of learning outcomes, there have been identified specific study courses and the amount of knowledge, skills and competencies to be acquired (see the mapping of the study program in Appendix 2.3.).

The correlation of the aims and learning outcomes of the study program with the learning outcomes of specific study courses can be found in each study course description, which provides a description of the course content, course plan, study requirements, learning outcomes, study methods, literature and other sources.

In the structure of the study programme, 106 credit points are compulsory study courses, 46 credit points are restricted elective study courses and 8 credit points are free elective study courses. The part of the limited choice comprises two specialised programmes: in the specialization B1- Software Engineering in the amount of 30 credit points, and in specialization B2 - Artificial Intelligence in the amount of 30 credit points. Out of 46 CP (restricted optional study courses), 16 CP is a part of the limited optional course, which applies to both B1 and B2 specializations.

The compulsory part of the study programme and the limited elective part of the programme include the guidelines, principles, structure and methodology of the field of computer science and software engineering and artificial intelligence (Programming - 8 CP, Computer and Computer Systems Architecture - 8 CP, Higher Mathematics - 8 CP, Discrete Mathematics - 4 CP, Probability Theory and Mathematical Statistics - 4 CP. Data structures and algorithms - 4 CP and others), history of the development of the field of computer science and current problems (Introduction to specialisation and digital skills - 4 CP, Object-oriented programming - 4 CP, Database design concepts - 4 CP, Operating systems and systems programming - 4 CP. and others), as well as the interdisciplinary aspect of computer science characteristics and problems (Introduction to Scientific Research - 2 CP, System Analysis and Modelling - 4 CP, Software Development Project Management - 2 CP, Applied Computing Methods - 4 CP, Cloud Computing and IoT - 4 CP, Cyber Security - 4 CP, Group Project - 2 CP, Applied Communication in Professional Activities - 2 CP and others).

The content of the programme is complies with the ACM/IEEE Computing Curriculum CC2020 and the EQANIE recommendations "Euro-Inf Framework standards and accreditation criteria for informatics programmes".

The study programme offers free choice study courses (part C), from which 8 credit points must be obtained to fulfill the programme requirements. The purpose of these study courses is to provide students with the opportunity to acquire additional knowledge in a field of science or to acquire skills useful for professional activity. Several elective courses are offered each year, such as Philosophy, Digital Marketing, etc. In addition to the study courses offered in the programme, the TTI students have the opportunity to choose the study courses from Part A or Part B of other study programmes as Block C courses, by matching them in the Study Department with their list of classes. Block C also offers new study courses developed by the lecturers in the field of study of the programme. After the completion of such courses, student feedback is collected on how interesting and useful the course was, and if the feedback is positive, the study course is included as an independent course in Part B of the programme.

The study programme also includes the content requirements of the study courses specified in the Law on Environmental Protection and the Law on Civil Protection (Occupational Safety, Civil and

Environmental Protection - 2 CP).

According to the agreement between the Institute of Transport and Telecommunications and UWE Bristol, when the programme is implemented in a double degree format, all study courses are taught by the Institute of Transport and Telecommunications (the TTI teaching staff). The specialization in Artificial Intelligence of the programne includes the study courses based on UWE Bristol materials (presentations, assignments, tests, exam questions and more). However, these study courses are also taught by the TTI teaching staff. The following UWE Bristol study courses are adapted and taught in the Artificial Intelligence specialization of the Bachelor programme: Academic Skills and Critical Thinking, Technical Writing, Foundations of Artificial Intelligence, Intelligent Systems, Artificial Intelligence Challenges and Research, Information Technology Project Management, Entrepreneurial Skills for the IT Industry.

When implementing the programme in a double degree format, TTI must adhere strictly to the quality processes implemented by UWE Bristol. In particular, at the beginning of each semester, the TTI teaching staff submit the assignments, the tests and the exam questions to UWE Bristol, where they are reviewed by the teaching staff appointed by UWE and an external expert (the so-called pre-assessmen moderation process).

During the semester, the study course is taught and all study works are evaluated by the TTI teaching staff.

After the semester course, all work within the course (assignments, exams and other tests that affect the final grade) must also be submitted to UWE Bristol, where UWE-designated teaching staff and an external expert check and assess whether the TTI teaching staff has followed the study course examination methods and assessment criteria submitted before the beginning of the semester (the so-called post-assessment moderation process).

Considering the need to comply with the UWE Bristol quality procedures and the fact that all materials are checked by the UWE Bristol lecturers and an external expert, all materials must be provided in English (including students’ reports, answers), it is not possible to provide a double degree programme in Latvian. The concluded contract does not provide the possibility of implementation of the programme in the form of distance learning, so this option is not included.

The study programme "Computer Science" with a specialization in Software Engineering is taught full-time in person, part-time in person, part-time by distance learning formats in the Latvian and the English languages; the programme with a specialization in Artificial Intelligence is provided in full-time in-person and part-time formats in English. So far, there has been no demand for studies in the double degree programme by correspondence, so the study group has not been set up.

The basis for quality assurance of the study programme is cooperation with potential employers by organising meetings and discussing issues related to the current labour market trends, labour market demand, listening to suggestions in the Study Programme Council, reviewing annual self-assessment reports of the programme.

The foundation of the quality assurance of the study program is cooperation with potential employers, organization of meetings for the discussion of issues related to the current issues on the labor market, demands of the labor market, reviewing annual self-assessment reports, receiving and reviewing suggestions from the Study Council.

The relevance of a course of study is also ensured by the proportion of faculty members recruited from the industry who are elected to the academic positions at TTI or are invited to teach individual courses, and their vision of the trends in the development of the subject matter of the relevant course of study in computer science. The correspondence of the study course content to the development trends in the field and science is also facilitated by the active practical, scientific and research activity of the programme academic staff - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities.

Study courses, including the contents of the course descriptions, are reviewed annually during the study programme and study direction self-assessment procedure, held in December and January in accordance with the course management regulations. As a result of such self-assessment, a programme development plan is drawn up, which comprises various aspects of the study course including updating of course descriptions following the specific field, labor market and science development trends.

There taken into account the feedback from the students in the study course evaluation questionnaires and the opinion of graduates and employers, providing input on the latest developments and current trends in the labour market. The updated courses are coordinated, approved and included in the study programme register and published in the e-learning environment Moodle by the beginning of the new academic year.

The assessment of the relationship between the aims and the achievable outcomes of the study programme and the aims and outcomes of the study courses shows that the content of the study programme and the study courses allows the achievement of the overall aims and outcomes of the study programme. The content of the study courses included in the programme is up-to-date and relevant to the needs of the industry, the labour market and the scientific trends. By successfully completing the programme, the students achieve the expected results of the programme and acquire knowledge, skills and competences that are in high demand in the labour market. The content of the programme courses ensures the continuity for studies in the higher level programmes.

3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study implementation methods, assessment methods, types and requirements are included in the description of each course available to students in the e-learning environment Moodle.

The study process is mainly implemented in the format of interactive lectures, seminars, workshops and student independent work. Courses include workshops, often discussions, role-plays, teamwork, project work, in-basket professional tasks or solving specific practical problems. The choice of a method depends on the learning outcomes that a lecturer is planning to achieve. The applied methods are geared to the development of the students' abilities, specifically, to learning, creative use of knowledge, cooperatation, self-evaluation, offering of alternative solutions to problems, to critical thinking and making responsible decisions.

The programme is taught full-time, part-time (organised on Saturdays) and part-time distance learning

The basic principles and procedure for the assessment of the acquisition of the study program comply with the requirements of Article 40 of the National Academic Education Standard. Pursuant to the regulations adopted by the TTI Senate, the results of the academic Bachelor's study program are evaluated according to two evaluation criteria: a quality criterion based on the 10-point marking system and a quantitative criterion - a credit point based on the total number of hours in the course. The complex method is used to assess the results of study courses. It includes assessment of students' practical work, individual or group work, mid-term assessment and final examinations (a test or exam). In order to facilitate students' independent work, it is stipulated that the final assessment (a test or exam) should not exceed 50% of the final mark for the course. In the beginning of a semester, students are informed about the components of the final mark and their assessment.

In practice, the evaluation process takes place regularly throughout the course of studies. The final assessment of students' learning outcomes is completed at the end of a semester after all stages of assessment are completed, such as practical assignments, seminars, independent work, mid-term assessment and examination. Teaching staff develop an assessment methodology, which indicates the percentage of each assessment criterion in the composition of the total mark.

At the end of the Bachelor's studies, students choose a theme for their Bachelor's thesis and in cooperation with their supervisors write and defend it.

In the variant of the double degree option, the study procedure and the methods used for the course delivery and assessment of learning outcomes are set out in accordance with the TTI and UWE Study Regulations (available on the UWE Bristol website: https://www.uwe.ac.uk/-/media/uwe/documents/about/services/academic-regulations-tsi.pdf). The learning outcomes at both programme and course level are assessed by the teaching staff of both universities.

In terms of studies, 2 programmes are implemented in the form of distance learning studies: the Master programme "Information Systems Management" and the Bachelor programme "Computer Science".

When studying via distance learning, the student learns the study content and takes the examinations using digital and online study tools, with no or minimal in-person attendance at the TTI. The procedure for the organisation of the distance learning mode of the study is described in the Regulations on the Organisation of the Distance Learning Mode of Study (https://tsi.lv/wp-content/uploads/2021/08/talm_nolikums_en.pdf).

Distance learning studies at TTI are provided by 2 distance learning study process organisation specialists who are directly responsible for the organisation of the study process for distance learning students, while the senior specialist of the Digitisation and Innovation Training Centre is responsible for the compliance of the technical design of study courses with the requirements set by TTI, in accordance with the content of the teaching-methodical materials of distance learning study courses (approved on 3.05.2019, Order No. 01-12.1/52, available in the TTI Record-keeping System). In order to ensure quality implementation of studies in distance education, TTI organises the methodological seminars and individual consultations for academic staff for the improvement of their pedagogical and digital competence and the acquisition of the targeted use of IT tools.

Each study course implemented in the study programme has a corresponding distance e-learning course. Each e-course provides students with the information on the organisation and communication of studies (contact details of lecturers and support staff, information on the study course, technical and organisational information, etc.), digital study materials (presentations and other materials developed by lecturers, video recordings of introductory lectures, links to articles and books in online databases, etc.) etc.), interactive learning materials (knowledge tests, etc.), opportunities for mutual communication and communication with the lecturer (forums, chat rooms, etc.) and the functionality of submitting and evaluating independent work (submission of independent work, electronic tests).

Distance learning study courses are assessed by mid-term and end-of-course examinations.

Intermediate test:

- Self-assessment tests - self-assessment questions are available in the e-learning environment in the form of a test with automatic answers, allowing students to assess their readiness for an intermediate test or a final test.
- Testing (with a grade) in the form of a test, as well as in the form of offline and online written or oral assignments as defined in each course.
- After obtaining a certain assessment in the intermediate examinations (the number of which corresponds to the number of credit points in the respective study course), the student shall be admitted to the final examination of the study course.

The test or exam is taken orally using the Moodle resource Big Blue Button. In addition, the course author may set a written test. For Bachelor programmes, the form in which the assessment is administered is determined by the course author and can be either a multiple choice test, an oral assessment using the Moodle resource Big Blue Button or a written assessment. Coursework is defended orally.

The grade is entered into the Schools' unified grade database in each student's personal card, which the student can access remotely.

The programmes use the latest IT technologies utilised by the computer industry during the Covid-19 pandemic. As is well known, most IT companies were able to provide remote working for their specialists, while retaining full software development and support functions. The programme includes both new courses in which cloud technologies are learned, as well as expanded use of cloud technologies in all other courses aimed at learning practical skills. These technologies, which are freely available to university faculty and students, fully cover the needs of the remote software development and support process. Such cloud services include GitHub (repository and version control), Kanban services (project management), MongoDB (database), Amazon and Azur cloud services (computing resources as a service), Kaggle.com (big data service for artificial intelligence), Kahut. com (online survey service), Moodle (universal learning management system), BigBluButton (video remote communication system), Coursera (professional training service), Choregraphe (virtual robot control system), MS Office 365 and Google Docs (documentation systems), and others. Special courses also address contemporary virtualization issues, including infrastructure as a program technology. As a result of the use of the mentioned technologies, the programme provides an opportunity for students to learn all study courses both in university in face-to-face mode and completely remotely. A wide range of online open educational resources is offered for students’ independent work.

From academic year 2023/2024 it is planned to implement the distance learning form of study in a new format, assuming that students remotely join the classes held on Saturdays together with students of the correspondence form of study (synchronous distance learning) and learn only part of the study courses in asynchronous mode.

In the first year of study, the distribution between synchronous and asynchronous format in terms of CP is planned: 4 CP (in asynchronous mode), the rest CP (in synchronous mode). In the first year of study, students will be able to take the following study courses in asynchronous mode: Labour Safety, Civil Defence and Environment Protection (2CP), Foreign language or Latvian language for foreign students (2CP), in total 4CP.

In the second year of study, two study courses are planned in asynchronous mode: Individual project -1 (2CP) and Free choice subject (2CP), in total 4CP, the rest of CP in synchronous mode.

In the third year of study, 12 CP are planned in asynchronous mode (Individual project -2 (2 CP), Business Communication in the Professional Activities (2 CP), Subject free choice (4 credits), Database Design Concepts (4 CP).

In the fourth year of study, the following study courses are planned in asynchronous mode: Individual project -3 (2CP), Subject free choice (2CP), System analysis and modeling 4(CP), Cloud Services Integration (2CP), Functional Programming (2CP), total 12 CP .

In the fifth year of study, the following study courses are planned in asynchronous mode: English for Career Management (2CP), Foundations of Start up Development (2CP), Bachelor's Thesis (CS) (10CP), Introduction to Scientific Research (2CP), Group project (2CP), total 18CP.

Intensive use of Coursera materials is planned for study courses in asynchronous mode.

The study methods used in the study programme contribute to the achievement of the course and programme goals and learning outcomes, provide student - centred education to encourage students to take an active part in the learning process and to ensure the appropriate assessment of students’ performance.

The principles of student - centred education and an individual approach to students are provided in the study programme:

- Learning outcomes. The evaluations of the study courses of the programme and the number of credit points are related to the learning outcomes. Students are informed about the results of each study course. The lecturers relate the results of the course to the results of the study programme, and also argue the necessity of studying the specific courses in order to become a computer science specialist in software engineering or artificial intelligence;
- Students are involved in the improvement of the content of the study programmes and study process through the students’ surveys, as well as through involvement in the collegiate bodies of TTI and the Student Self-Government. Therefore, the students are provided with the opportunity to influence their own study process. Student representation in collegiate bodies is discussed in criterion 1.2 of the study field, the results of the student survey are shown in Appendix 7.
- Access to education and personalization of studies. When students study in the programme, a flexible study process is provided - various forms of study (on-site full time, part time, distance learning), the opportunity to create an individual study plan, which gives students the opportunity to combine work with studies already from the second year. Also, students of the day department have the opportunity to change the form of studying to part-time studies or distance learning in order to combine studies and work. Access to education is ensured by

a digitized study process (e-library), discounts, social support (for foreign students, students who come to the university as part of mobility).

- Development of academic staff competencies. Pedagogical methods, study course structure and evaluation methods are chosen by the teaching staff responsible for the study course, according to the specification of the course content and programme, as well as the needs of the students. Courses and seminars on the latest teaching and pedagogical methods are organised for academic staff, as well as the attendance of qualification improvement courses is encouraged, both at internal faculty events, at the level of TTI, and internationally. More details are in the description of criterion 2.3.6 of the study field.
- Students receive feedback, which usually provides advice on the learning process and on ways to improve their learning and research skills.
- In the organization of research work (in the selection of topics of study projects and final theses), the field of interest of the students, the specificity of the practical work and experience are respected.
- Assessment is consistent, applied equally to all students and is carried out in accordance with the approved procedures, and learning outcomes are assessed in accordance with the Regulations on the Charter of Studies. The assessment criteria for each course of study must be communicated to the students by the teaching staff in the first lecture, and they are published in the TTI e-study environment. The description of each course specifies the connection of the study course evaluation criteria and methods with the learning outcomes of the study course, as well as specified conditions for taking exams. (See Appendix 3.5, descriptions of the study courses of the Bachelor study programme "Computer Science")
- Procedures for examining the student appeals are in place and have been communicated to the students.
- Admission procedures and criteria are open. Admission rules with a detailed description of each programme are published on the TTI website in Latvian and in English.
- An information system has been created to ensure that the students can progress in their studies. More details are available in the description of criterion 2.3.4 of the study field.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

Students choose themes of their Bachelor's theses independently from the list of research directions for Bachelor's theses offered by the Faculty. The offered themes are broad and comprehensive. Together with the supervisor of the final Bachelor’s thesis, a student can make corrections and specify the theme. The student can also propose his or her own research theme. This is usually the case when the student is already working and the chosen research topic will help him or her to acquire professional competences in a specific field.

The list of possible research areas offered by the Faculty is updated annually, taking into account the development trends in ICT and global trends in economics, politics and society, which affect the needs of the labor market and create new requirements for the education of modern aviation professionals.

Appendix 2.8 provides a list of examples of bachelor thesis topics that were defended in recent years.

The final theses of the students of the “Computer Science” programme are relevant both to the company in question and to the industry as a whole. The sample themes of the Bachelor theses are developed on the basis of both experience of academic staff and of the recommendations of the employers.

Students’ theses developed in cooperation with IT companies (Accenture Latvia, C.T.Co etc.) are of particular practical importance. They give students the opportunity to delve into the companies' current problems and look for possible solutions in a real aviation environment. Since the IT field is a very dynamic industry, such an approach is of great benefit to students.

The final examinations of the programme are assessed by a panel, which also includes the industry professionals who assess the relevance of the work, the students’ knowledge and the presentation skills. The undergraduate exam committee is chaired by Anatoly Plotkin, Specialty Lead at Accenture, who is a representative of the employers.

Every year the students of the programme participate in the final thesis competition “ZIBIT”, organised by “Accenture Latvia£ in cooperation with the foundation “Development Fund of Riga Technical University “ and other IT companies, regularly winning the prizes, e.g.: Sokolov Viktors “Development of a system for personal expense accounting using optical character recognition” won the 2nd place in 2020, Dmitrijs Anohins “Development of smart traffic light control systems” won the 1st place in 2017.

The grades of the final theses are different, but this indicates not only the level of knowledge, but also the ability to concentrate when speaking in front of the public, the ability to argue, motivate and defend one’s opinions and proposals. As can be seen in the 2022 Bachelor theses evaluations, most final theses were evaluated in the range from 7 (good) to 9 (excellent), which represents 76% of all defended Bachelor theses, of which 8 theses were rated as “excellent”, 8 works as “very good” and 14 final works as “good”. 18% of students received the grade 6 (almost good), and 5% – the grade 5 (satisfactory). The positive evaluations of bachelor theses show the high scientific quality of bachelor theses, the ability to defend the research results convincingly and argumentatively, as well as the graduates’ preparation and suitability of the graduates for the labour market. The highest grade of “excellent” is awarded only for outstanding performance and if the student has presented at an international or national conference, prepared a scientific publication, etc. In the last three years, only one final thesis has been awarded an “excellent” in the Bachelor programme. This only confirms the serious attitude of the final examination board in assessing the performance of each student. No unsatisfactory marks have been received in the last 3 years.

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

In the study direction report in sections 2.3.2. - 2.3.4 the full information on these issues is provided. In this paragraph there is only additional, separately highlighted and emphasised additional information on the study programme.

The study process is mainly provided by the staff of the Faculty of Engineering of TTI. In addition to that, the staff of the Faculty of Transport and Management Sciences are involved in the humanities and social studies courses

The Faculty of Engineering of TTI provides teaching and methodological work: creates and updates study course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and provides defences of bachelor theses and carries out other activities related to teaching, methodological and scientific work. The Digitisation and Innovation Learning Centre is responsible for the development and deployment of teaching methodological materials for distance learning study courses on the TTI Learning Management System platforms.

In order to provide students with practical experience, the laboratories of TTI are used intensively during the studies. Practical and laboratory work is carried out in the laboratories, and the laboratories are also available to students outside of study time. During their studies, the students of the “Computer Science” programme use the TERC laboratories, which ensure the implementation of the study programme, and in addition, the Software and Information Systems Development Laboratory (DevLab) is available to students. In this laboratory, the students have the opportunity to increase their professional competences in programming and algorithmics. The laboratory provides students with the opportunity to participate in internal projects of TTI - development of TTI information systems, e.g. TTI CMS (Curriculum Management System) was developed with the involvement of students, and to be involved in contract research carried out by TTI. With active participation of students, the following projects were implemented: Development of the slot system for multiplex IHC staining - in this project a group of students (3 students) is involved in the development of the device control software and the development of a software graphic interface; Development of FARO Laser Scanner External Panoramic Camera- in this project a group of students (4 students) is involved in the implementation of the system control algorithm, etc. Students have the opportunity to get involved in the activity of the research clusters and to carry out more projects, focused on the research, e.g. in 2021, within the framework of the Data Analysis and Artificial Intelligence Research Cluster, 1 master student and 2 bachelor level students were involved in a project of 3d point cloud algorithm development research to study the development of a 3d point cloud algorithm. Information on the possibility to participate in the projects or other activities is disseminated both on the TTI website and through the individual student recruitment, taking into account their desire to gain practical experience.

The common study, scientific, informational (including library), material-technical and financial base of TTI and the Faculty of Engineering creates prerequisites for the achievement of study results and indicates the possibility to ensure a high - quality study process for the study programme “Computer Science”. For the effective implementation of the study programme, the academic staff and students at the faculty have access to the auditoriums equipped with the latest generation of visual and audio equipment, as well as highly certified and evaluated laboratories, which correspond to the specifics of the study programme and the conditions for its implementation.

In the reporting period, for the needs of the study field, TTI has acquired infrastructure for laboratories, practical classes (e.g. modelling computer programmes) and lectures (e.g. scientific literature, databases of scientific articles), computer equipment (monitors, computers, presentation lasers), laboratory equipment (for details, see Appendix Laboratories of the study field).

The TTI library is available for use by students of the “Computer Science£ study programme. In 2019, as part of the STEM project, around 3000 new books were purchased for a total amount of EUR 10 000 for needs of the direction from various scientific publishers. For example: Springer, Tailor&Francis, Elsevier, etc. 90% of these books were purchased in electronic format and are available to users via the library electronic catalogue. In the following years, the collection of the library was supplemented with newer books relevant to the field. The library has 29 890 documents available for the students of TTI, of which the following are specific to the field: books - 14 146, e-books - 2588, periodicals -1072; and the following databases are subscribed to: the Academic Complete e-book database, where the number of books in the field of Computer Sciences has 7075 titles. The availability of e-literature is particularly important for distance learning students.

Under the collaborative agreement between the Institute of Transport and Telecommunications and UWE Bristol, students studying on a double degree programme are matriculated as both TTI and UWE students. In addition to TTI, students are also registered in the UWE Bristol student database, students are provided with UWE Bristol student usernames and passwords to be able to access UWE Bristol resources, for example, library, software repository, student card and so on. At the same time, it has been separately agreed with UWE Bristol that the UWE modules included in the programme (for example, Artificial Intelligence module) are available to TTI teaching staff who use the module content (presentations, assignments, exams and other) for teaching at TTI. All content material is published in the TTI LMS system for students’ convenience, for example the Foundation of AI module is modeled after the UWE Bristol material but published in the TTI LMS system.

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the moment when the programme was founded, income from the tuition fees has been the main source of funding for the study process. The study programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee per full-time student is EUR 2200 per year, per part-time student - EUR 1760 per year, distance learning - EUR 1500 per year. The amount of tuition fees for each academic year shall be determined and approved by an order of the Rector. The tuition fee payment procedure is laid down in the Regulation on the tuition fee payment procedure, which provides for the possibility to pay the tuition fees for the entire study programme as a whole, for one academic year, for one academic semester or as a monthly payment (starting from the 2nd semester).

The tuition fees for the double degree programme are higher – EUR 5 600 per year, since among other things, it includes a double study results assessment system. The results of all study courses in the programme are assessed first by TTI and then by UWE Bristol academicstaff.

The breakdown of funding between TTI and UWE Bristol cannot be specified in this document. Funding (payments made by students for their studies) is distributed according to the terms of the contract. The agreement contains commercially sensitive information, and therefore, TTI has no right to disclose commercial information without the written consent of UWE Bristol.

See Appendix 3.7 for average costs. There is no difference in the cost of studying in Latvian and English, since the studies are delivered at a high quality level without a breakdown by language of study, so there are no different tuition fees.

The cost structure of the study programme in the last academic year 2021/2022 includes salaries and taxes (including costs of scientific publications, etc.) (including the payment of the costs of publications and other similar costs, in accordance with the TTI academic staff remuneration regulations) in the amount of 56%, study programme development and implementation costs in the amount of 5%, teaching materials and other similar costs in the amount of 9%, scientific infrastructure costs and other similar costs amounting to 12% of the volume, advertising and marketing costs amounting to 2% of the volume, infrastructure costs (including IT costs) amounting to 9% of the volume, depreciation and amortisation 5%, other administrative costs 2%.

Every year TTI offers to the students the opportunity to receive personalised discounts of 50%, 75% and 100% on full-time tuition fees, which are awarded on a competitive basis. Applicants are evaluated on the basis of the results of the national centralised examinations, the average grade of the certificate, motivation and other additional achievements. Students have the opportunity to obtain scholarships from companies, in the “Computer Science” programme such scholarships are provided by Clarity Labs, and to inspire girls to pursue a career in STEM fields, scholarships are offered by Birkle IT.

In order to be profitable, the programme must have at least 10 students. It is taken into account that the study programmes of the field of the study respect the continuity of the study courses, as well as the study plans of each programme are mutually coordinated - the courses included in the plan and their sequence by semesters. There are general education courses such as Occupational Safety, Civil and Environmental Protection, Higher Mathematics, Foreign Language, or Programming, but there are courses such as Computer and Computer Systems Architecture, which are taught in the 1st and in the 2nd semesters of the “Computer Science” programme in the amount of 8 CP, while in the Computer Engineering and Electronics programmes they are taught only in the 1st semester in the amount of 4 CP, and so on.

Group of 10 students is given as the average number. As already mentioned, several courses are taught jointly for different programmes. In full-time face-to-face studies, the costs are higher, therefore a larger number of students is needed - 12, in part-time studies - 8. The language of study does not affect the amount of costs. In part-time distance learning, the minimum number of students is 1.

This procedure saves money and makes the programmes cost-effective even with fewer students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The teaching at the study programme is provided by 27 memebers of academic staff with the relevant academic experience and qualifications, 20 of whom are elected lecturers.

8 full professors of TTI are involved in the implementation of the compulsory and limited elective part of the Academic Bachelor programme “Computer Science”, including 7 people with doctoral degrees in the relevant scientific field: Dr.sc.ing. A.Grakovskis, Dr.sc.ing. I.Jackiva, PhD E.A. Merchan, Dr.sc.ing. B.Mišņevs, Dr.sc.ing. D.Pavlyuk (second doctoral degree in Economics), Dr.sc.ing. I.Pticina, Dr.sc.ing. M.Savrasovs and Dr.sc.administr. J.Stukalina; and one associate professor Dr.sc.ing. N.Spiridovska. P (), Dr.sc.ing.I.Pticina, Dr.sc.ing.M.Savrasov and Dr.sc.administr. J.Stukalina; Dr.sc.ing. N.Spiridovska. Therefore, it can be concluded that the qualifications of the academic staff involved in the implementation of the study programme fully comply with Article 55 point 1 of the Law of the Republic of Latvia “Law on Higher Education”, which stipulates that not less than five professors and associate professors who have been elected to academic positions at the respective higher education institution participate in the implementation of the compulsory and limited elective part of the academic study programme.

In addition to the above presented list of professors, 5 assistant professors and 6 lecturers are involved in the implementation of the programme, 2 of whom - O.Zervina and A.Vesjolijs - are doctoral students of the doctoral programme implemented in the field of study.

A total of 70% of the academic staff involved in the programme have doctoral degree in science - 11 in engineering and 3 in social sciences.

The study process involves not only the academic staff of the field of study, but also a number of specialists from the industry, including foreign academic staff, who with their professional experience not only deepen the students' practical knowledge and skills within the study course, but also increase the students' employment opportunities after graduation from the programme.

2019.gadā 8.2.2.ietvaros sadarbību ar TSI uzsāka ārvalstu docētājs Omar Youssef Yasser Moustafa Kamal Abdelmonem, kurš sadarbību turpina un pašlaik angļu valodā programmā docē Cloud Computing & IoT.

Currently, only 4 of the elected faculty members work in the companies in the industry: J.Revzina, Ltd. iPro cyber security engineer and Cisco Networking Academy instructor, E.A.Merchan, Robotic Solutions engineering director, J.Kijonoka, Accenture Latvia data scientist. Another invited guest lecturer representing Accenture Latvia employer company is R.Biswas, who teaches the Cloud Services Integration course in English.

In 2019, within the framework of 8.2.2, a foreign lecturer Omar Youssef Yasser Moustafa Kamal Abdelmonem started the cooperation with TTI; he continues the cooperation and currently teaches Cloud Computing & IoT in English.

The leading lecturers from other universities or specialists in the specific field of knowledge are additionally engaged in the study programme, for example, N. Šlendins, lecturer of the National Defense Academy teaches at TTI the course "Labour Safety, Civil and Environmental Protection" for the students of all streams; Ioseb I. Gabelaia, Director of the Public Relations and Advertising Management programme at the RISEBA School of Business, Arts and Technology, teaches the course "Critical Thinking".

3 of the invited guest lecturers have degrees of Doctor of Sciences, the others have Master degrees.

Some courses have several lecturers, or the main course is taught by the programme director, but it is already expected that that the representatives of the industry will be invited as guest lecturers for some topics, thus ensuring both the quality and relevance of the study course content.

In order to improve the quality of the programme, the lecturers deliver courses in one of the two languages only. Lecturers carry out scientific research and participate in the education of students. The Institute of Transport and Telecommunications ensures the professional development of its staff as far as possible and provides incentives with a remuneration, which is competitive in Latvia.

Foreign teaching staff: Biswas Rantu (Integration of Cloud Services), Gabelaia Ioseb (Academic Skills and Critical Thinking), Merchan Emmanuel Alejandro Cruz (Business Skills for the IT Industry) teach only in English in the study programmes for both students who study the programme in English and students who learn in Latvian, taking into account that the university has the right to implement no more than one-fifth of the credit points of the study programme in a foreign language (article 56, paragraph 3 of the Higher Education Law, and paragraph 5.1.2 of the TTI study agreement).

The knowledge of the state language by the academic staff involved in the programme complies with the Cabinet of Ministers' Regulation No. 733 of 07.07.2008 "Regulations on the scope of knowledge of the state language and the procedure for testing state language proficiency for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union, and the state fee for testing the knowledge of the state language". The TTI Human Resources Department verifies the skills in the state language at the time of recruitment.

In order to ensure the English language proficiency of the academic staff, TTI periodically organises English language proficiency tests and, if necessary, additional training, e.g. in the academic year 2019/2020, several of the academic staff improved their English language proficiency in the courses organised within the project 8.2.2. and repeated English language courses are planned in the future from the university own funding.

The qualifications of the teaching staff involved in the implementation of the study programme meet the conditions for the implementation of the study programme and the requirements of the regulatory enactments, ensure the achievement of the goals and study outcomes of the study programme and the corresponding study courses.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In the period since the previous accreditation in the academic year 2012/2013, changes have occurred in the composition of the academic staff involved in the implementation of the Bachelor programme "Computer Science".

Position	2012 /2013 academic year			2021 /2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professors	6		6	8		8
Associate Professors	4		4	1		1
Assistant Professor	3	3	6	5		5
Lecturers		8	8		6	6
Guest lecturers	3	2	5	3	4	7
Total			29			27

Although the total number of lecturers is almost unchanged, only 9 lecturers currently teaching in the programme worked during the previous accreditation. During the reporting period, 11 new lecturers (elected by TTI) were recruited to the programme to teach a specific study course or part of a course. Of these, eight lecturers have doctoral degrees, three are full professors, one is an associate professor, three are assistant professors, three lecturers. Some representatives of the academic staff are graduates of the study programmes of different years.

Changes in the composition of the academic staff are influenced by several factors. One of them is the generational change, since many lecturers were in the pre-retirement age group at the time of the previous accreditation. Currently, a large number of young lecturers (up to 45 years old) are teaching in the programme. A number of faculty members have upgraded their academic experience and have been elected to higher positions. Two of the lecturers of the last accreditation period have obtained doctoral degrees and hold professorships: I. Pticina and J. Stukalina, as well as several academic staff who have also obtained doctoral degrees and higher positions during this period. For example, M.Savrasov, a 2004 graduate of the “Computer Science” programme, obtained a Doctor of Science degree in 2013, was elected as an Associate Professor in 2016, obtained the right of Latvian Council of Science Expert in 2020, and was elected at a Professor position in 2021.

Currently O. Zervina, A. Vesyoly, O. Skorobogatova are studying in doctoral course.

The choice of lecturers is determined by the content of the study programme, which is continuously improved according to the rapid development of the ICT industry. The programme includes study courses that provide future competences; the faculty members specialising in the field are invited to deliver these courses. They include the specialists from the professional environment. For example, study courses related to the artificial intelligence are taught in the Bachelor and Master level computer science programmes by J. Kijonoka, a data scientist at Accenture Latvia.

This makes it possible to ensure the connection of the programme with practical activities, since the information is obtained directly from the industry professionals, and generates more interest among students.

The reduction of the total number of academic staff by 2 does not affect the quality of the programme in any way. The previous evaluation of programmes in this study field took place in 2012, but the data submitted for evaluation was for year 2011. Taking into account the rapid development of this field, the “Computer Science” programme over the past eleven years naturally included both new courses and changed the subject matter of the existing courses (more details are available in the description of criterion 3.1.1). The number of TTI professors and foreign teaching staff has increased, as well as the number of invited guest lecturers representing the industry, which has a positive impact on the quality of the programme.

During the reporting period, the University made a concerted effort focused on the composition of the academic staff in order to ensure the quality of the study programmes in the best way. The human resources development plan of the faculty was elaborated, which provides for the improvement of the quality of study programmes by promoting the growth of the existing academic staff, attracting academic staff recognized in the academic environment, experts and professionals in the field, foreign guest lecturers, as well as students and graduates of the doctoral study programme of the university.

In general, it can be concluded that the changes in the structure of the academic staff involved in the study programme can be evaluated positively, that the relevant qualifications and experience of the academic staff in academic work ensure a high quality of education and that it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in

Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for mutual cooperation between academic staff, which promotes the development and interconnection of the study courses. The improvement of the study courses is carried out on a regular basis, based on suggestions made by students, industry development trends, and the latest results ofthe research, scientific activities and innovations.

During the implementation of the study courses and scientific work, regular meetings of teaching staff take place, in which they exchange experience on the study course topics, results of scientific work, new developments in the research, etc. Discussions are used to develop and improve the content of studies, with mutual agreement on topics, emphases, responsibilities and compliance with regulatory requirements.

The knowledge acquired in other study courses is taken into account in the design or development of the content of the study courses, indicating it as the required prior knowledge.

For example, in preparation for the programme evaluation, the content of the programme was reviewed and faculty members mutually agreed on the extension of some courses of study to reduce the number of small 2 CP courses in the programme as much as possible.

Taking into account that the study programmes are taught in several languages, and, to improve the quality, the same courses are often taught in Latvian, English (and Russian until summer 2023) by different faculty members, all faculty members related to a particular course are involved in the process of course coordination in order to harmonise the topics to be covered during the classes and to ensure common requirements. This ensures that the topics covered in the study programme are continuously developed and updated in close mutual cooperation.

Within the framework of the study programme, cooperation with employers and professional organisations is carried out through seminars, conferences, as well as through personal contacts of lecturers, analysing the competence of students and graduates, and addressing issues of graduates’ future employability.

The connection with the employers is also strengthened through the active participation of the study direction faculty members in professional organisations and associations, the most important of which are the Latvian Information and Communication Technology Association (LIKTA), the Latvian Electrical Engineering and Electronics Industry Association (LETERA), the Mechanical Engineering and Metalworking Industry Association (MASOC), the Remote Piloted Aircraft Association (LARPAS), the Simulation Modelling Society, the European Conference of Transport Research Institutes (ECTRI), Informatics Europe, etc. c.

As part of the study process, the preliminary defences are organised with the participation of a committee of faculty members, where the recommendations are collectively made to improve the bachelor theses. Consequently, mutual cooperation between lecturers of different fields is ensured and allows comprehensive recommendations for the development of bachelor's theses. The same cooperation is observed after the defence of the bachelor theses, when the Final Examination Board gives its evaluation as a result of the discussion, based on the evaluations proposed by the members of the Board. The committee is composed of leading faculty members, and the chair of the committee is a company representative, in this case Anatoly Plotkin - Specialty Lead at Accenture.

Experienced researchers working at the Faculty of Engineering participate in the research projects and activities funded by the Latvian Council of Sciences, the European Commission and other international funding sources and foundations in cooperation with partners in universities and research institutions in Latvia, European Union Member States and worldwide: I.Kabashkin, I.Jackiva, M.Savrasovs, D.Pavlyuk, B.Mishnevs.

The total number of lecturers involved in the implementation of the programme is 27, while the total number of students on October 1, 2022 in full time in person and part time correspondence department was 590, in distant learning department they were 160, thus the ratio of students to lecturers is 1:21, and in distance learning department - 1:6.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annex 2.6 Sample of the diploma.zip	2.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)		
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 2.1 Statistics on the students.docx	2.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 2.2. Compliance with the State Education Standard.docx	2.2.pielikums. Atbilstiba izglitibas standartam 3001 2.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 2.3. Mapping of the study courses.xlsx	2.3.pielikums.Studiju kursu kartejums 3001.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 2.4.. The curriculum of the study programme.zip	2.4.pielikums.Studiju plans.zip
Descriptions of the study courses/ modules	Annex 2.5. Descriptions of the study courses modules.zip	2.5.pielikums. Studiju kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 2.9 Confirmation.docx	2.9.pielikums. Apliecinajums atbilstiba AL.pdf

Computer Engineering and Electronics (43523)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Computer Engineering and Electronics*
Education classification code	*43523*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Aleksandrs*
Surname of the study programme director	*Kraiņukovs*
E-mail of the study programme director	*Krainukovs.A@tsi.lv*
Title of the study programme director	*Dr.sc.ing.*
Phone of the study programme director	*28316834*
Goal of the study programme	*To provide undergraduate education in Computer Science and Electronics, which forms graduates' competencies necessary for successful professional activity and knowledge development in the fields corresponding to the specialisations of the study programme: Embedded Electronic Systems, Industrial Electronics, Telecommunications Systems and Computer Networks.*

Tasks of the study programme	*1. to provide a comprehensive education in technical field study courses, which are considered as core courses for the three curriculum areas: Electrical Engineering and Electronics, Processing Devices, Programming, Automatic Control, Telecommunications and Computer Network Technologies;* *2. to provide learning of the Mathematics and Physics sections necessary for solving the practical tasks of embedded electronic systems, telecommunications systems, computer networks and industrial automation systems;* *3. to develop students' algorithmic thinking and create the practical programming skills necessary for the development of software applications for modern processor devices;* *4. to provide basic knowledge of telecommunication systems and computer networks and to develop skills in modelling and designing their structural components;* *5. to provide the understanding of the principles of design and operation of electronic devices and embedded systems, as well as the formation of the practical skills in their modelling and design;* *6. to develop students' knowledge of automatic process control methods, as well as to provide them with skills in the application of optimal control methods and artificial intelligence algorithms;* *7. to develop students' knowledge of the principles of construction and functioning of automated control systems for production facilities and technological processes;* *8. to provide practical work experience of an engineer in computer technologies and electronics by carrying out the laboratory work in electronics, telecommunications, computer networks, automatic control systems, embedded systems programming;* *9. to develop the students' skills in independent solving the practical tasks in computer technology and electronics by performing the design work in each academic year;* *10. to develop students' understanding and knowledge of the principles of work organisation, social issues and economic activity.*

Results of the study programme	*• to have basic knowledge and understanding of the fundamental scientific and engineering principles of Computer and Electronic Engineering in general and in the following specialities: Embedded Electronic Systems, Industrial Electronics or Telecommunications Systems and Computer Networks; • to know and to be able to apply the principles of integration of electronic equipment, processor devices and software applications; • to be able to design the embedded electronic devices and systems using microcontrollers and microcomputers; • to know and to be able to apply the principles of organisation, design and maintenance of telecommunications systems and computer networks; • to be able to design the industrial electronics systems and devices, to develop the technological operations and process control programmes and to perform the maintenance of the industrial automation systems • to be able to work effectively both independently and in teams with minimum supervision to perform the design and production tasks; • to be able to improve continuously the professional skills by analysing the development features of Computer Technology, Electronics, and Computer Networking and Telecommunications Technologies; • to be able to organise and manage communication in a professional environment, respecting the principles of professional and general ethics.*
Final examination upon the completion of the study programme	*Bachelor's Thesis*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*

Language	*english*
Amount (CP)	*160*
Admission requirements (in English)	*Completed secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) , except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Physics and Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*english*
Amount (CP)	*160*

Admission requirements (in English)	*Secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) , except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Physics and Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

No.	Parameter	Changes made in the period since the previous accreditation	Changes made in the process of accreditation
1.	Field of Study		---
2.	Name of the study programme		Changed from “Bachelor of Engineering in Electronics” to “Computer Engineering and Electronics”, since this name is widely used in the international environment and more accurately describes the content of the programme, as well as following the experts’ recommendations - the programme name should not duplicate the awarded degree.

3.	The code of the study programme in accordance with the Latvian Classification of Education		---
4.	Type and level of the study programme		---
5.	Amount of the study programme (KP)		---
6.	Form, type, duration of programme implementation		---
7.	Language of instruction		Latvian and English languages. The programme was previously also accredited with Russian as a language of instruction, the last students studying in Russian will graduate from the programme in June 2023. *Article 49 of the Transitional Regulations of the Law on Higher Education, according to which it is prohibited to enrol students for studies in Russian after January 1, 2019.*

8.	Place of implementation		---
9.	Director of the study programme		Due to the change in the personnel composition, from January 2022 the Director of the programme is Dr.sc.ing., associate professor Aleksandrs Kraiņukovs, who is also a long-term leading teaching member of the programme
10.	Admission requirements	With the AIP decision No. 1.10/28 of November 15, 2018, the additional admission requirements for foreign applicants have been agreed - a test in English, Physics and Mathematics	---

11.	Awarded degree		Changed from “Bachelor degree in Engineering in Electrical Engineering” to “Bachelor degree in Engineering in Electronics and Automation”, specifying it in accordance with the Cabinet of Ministers Regulation No. 322 “Regulations on the Classification of Latvian Education” for the group of programmes with code 523.
12.	The goal of the study programme		Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.

13.	Tasks of the study programme		Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.
14.	Learning outcomes		Learning outcomes have been refined in line with the goal of the programme, updated study course outcomes and European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) requirements for level 6, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.

15.	Final test		---

Changes to the name of the programme

TSI has so far implemented 3 one-track programs: the academic bachelor's programs "Bachelor of Engineering in Electronics" and "Telecommunications Systems and Computer Networks" and the second-level professional program "Electronics". Already during the previous accreditation, experts pointed out the ineffectiveness of two electronics programs, taking into account the small number of students. In discussions with employers and representatives of associations of the relevant direction, it was decided to expand one of the programs "Bachelor of Engineering in Electronics", opening appropriate specializations and changing the name of the program itself to "Computer Engineering and Electronics". The name of the program was chosen based on several circumstances:

- analysis of trends in the development of applied processor electronics, industrial electronics, telecommunications and computer network technologies;
- analysis of requirements for competences of technical specialists in listed industries in Latvia and the European Union;
- studying the recommendations of the Association for Computing Machinery (ACM) IEEE Computer Society for Undergraduate Degree Programs in Computer Engineering;
- analyzing the aims, objectives and structure of similar bachelor's programs implemented in the universities of the USA, Great Britain and EU countries.

Computer engineering is a branch of technology that embodies the science and technology of designing, constructing, implementing, and maintaining software and hardware components of modern computer systems, computer-controlled equipment, computer networks, and intellectual devices.

Traditionally, computer engineering represented a combination of electronic engineering and computer science, but over the past decades, computer engineering has turned into a separate branch based on electronic engineering and computer science. At the same time, the interface between electronics and computing is a key area of growth for the industry of high technologies, telecommunications, information, computer networks, and sensor technologies. Охарактеризованные программы и вмедионсвязь медух computer engineering и electronics determine the name of the bachelor's program: «Computer Engineering and Electronics».

Changes in the structure of the programme

The main changes in the structure of the "Computer engineering and electronics" program are related to the inclusion of three specializations in the program: "Embedded electronic systems", "Industrial electronics", "Telecommunications systems and computer networks". The inclusion of three specializations in the program is explained to specialists with the trends in the development of these branches and the demand for specialists in these fields.

Specialization "Embedded Electronic Systems" includes special study courses related to the direction of computer engineering and which were not included in the bachelor's program "Electronics": "Software Engineering", "Data Structures and Algorithms", "Operating Systems", "Computer Design of Digital Equipment", "Embedded Fundamentals of System Design", "Advanced Microcontrollers", "Computer Networks", "Microcomputer Embedded Systems", "Internet of Things Engineering" and "Cyber Security".

The specialization "Industrial electronics" covers special study courses from the professional program "Electronics" and study courses that provide students with the necessary competencies for successful operation in the field of industrial and transport automation: "Sensors and actuators of automated systems", "Analog devices", "Power electronics", "Programmable logic controllers and their programming", "Automated system design", "Automation of building engineering systems" and "Development of automated industrial systems".

The curriculum of the specialization “Telecommunication systems and computer networks” was formed using special study courses that were in the curriculum of the bachelor’s program “Telecommunication systems and computer networks”, with the exception of the study courses: “Defenses against Malware” and “Applied Numerical Methods”, since lost relevance in the new program, but the study course " Engineering of Internet of Things " is included.

All three academic undergraduate programs "Bachelor of Engineering in Electronics" and "Telecommunications Systems and Computer Networks" and the second-level professional program "Electronics" were based on the same set of general basic education and special study courses. The basic set of study courses of the academic bachelor's study program "Computer Engineering and Electronics" has remained practically unchanged. It did not include the study course "Microwave Electronic Engineering", and instead of the two study courses "Theory of Electric Circuits" and "Fundamentals of Electric Circuit Theory", only the first of the two remained. At the same time, the volume of the Physics course was increased (6 credits instead of 4), and the courses Database Design Concepts, Digital Circuit Engineering, Computer Networks-1, Computer Networks-2 became common basic courses for all three specializations.

The structure of the program ensures the development of project competencies of students. The program includes three individual courses and one group project, which are performed annually by students all three specializations. Such changes contribute to the formation of students' practical professional competences and improve interdisciplinary communication in the program.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The name of the Bachelor study programme “Computer Engineering and Electronics” indicates that the programme belongs to the Engineering and Technology branch group Electrical Engineering, Electronics, Information and Communication Technologies and thus logically fits into the study field Information Technology. In accordance with the Cabinet of Ministers Regulation No. 49 of 23.01.2018 “Regulations on branches and sub-branches of Latvian science”, it logically fits into the study field “Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”

The study courses included in the programme basically cover two fields of science: computer science and electronics.

Compulsory courses that correspond to these two areas and are common to all three specializations, included in parts A and B of the programme, make up a total of 66 CP and are divided by the following amount of credit points:

- 5% - credit points consist of study courses in the science branch " Electrical Engineering, Electronics, Information and Communication Technologies";
- 5% - credit points consist of study courses in the field of science "Computer Science and Informatics".

Such a distribution of credit points as a percentage indicates that the bachelor's study programme does not belong to the group of computer science programmes.

The scope of the embedded electronic systems, industrial electronics, telecommunications systems and computer networks specializations of the programme is 36 credit points each. Students must choose one of these specializations during their studies.

Each specialization is characterized by its own distribution of credit points in two main fields. The most even percentage distribution of credit points is in the specialization "Embedded Electronic Systems": 56% - CP in the science field "Electrical Engineering, Electronics, Information and Communication Technologies", and 44% - CP in the science field "Computer Science and Informatics". Such a percentage distribution of credit points shows that the specialization "Embedded Electronic Systems" fully corresponds to the field of science and technology "Computer Engineering".

All study courses of the specialization "Industrial Electronics" belong to the field of science " Electrical Engineering, Electronics, Information and Communication Technologies ".

In the specialization "Telecommunication Systems and Computer Networks", the percentage distribution of credit points looks like this: 67% - credit points in the science field " Electrical Engineering, Electronics, Information and Communication Technologies", and 33% - credit points in the science field "Computer Science and Informatics". This distribution of study courses corresponds to telecommunications development trends of systems and computer networks and the scientific and technical direction of "Computer Engineering".

In general, the affiliation of the study courses included in the programme to the science sector confirms that the programme "Computer engineering and electronics" itself belongs to the study direction "Information technologies, computer engineering, electronics, telecommunications, computer management and computer science”.

At the same time, the described percentage distribution of credit points for study courses in three specializations allows us to conclude that the study programme “Computer Engineering and Electronics” is aimed at training specialists in the fields of electronics and automation, because:

1. Courses related to electronic engineering are considered basic for all three specializations of the "Computer Engineering and Electronics" programme, and courses related to "Computer Science and Informatics" are complementary, corresponding to modern integration of electronic engineering and computer science.
2. Educational courses of specialization "Embedded Electronic Systems" are aimed at the formation of knowledge and practical skills of graduates in the field of electronic devices based on microprocessors, microcontrollers and microcomputers, that is, such devices that are built into technical and household objects of various purposes, to solve the tasks of automatic control of these objects.
3. The study courses of specialization "Industrial Electronics" are intended for the formation of graduates' knowledge and practical skills in the field of industrial electronics automation systems, which are used in the automation of industrial production and technological

processes.

4. The study courses of the "Telecommunications Systems and Computer Networks" specialization are designed to build graduates' knowledge and practical skills in the areas related to the construction and operation of electronic processor devices that ensure automatic data collection and transmission in accordance with data transmission protocols.

Therefore successful completion of the programme leads to the award of a bachelor of Engineering degree in Electronics and Automation, which complies with the Cabinet of Ministers Regulation No. 322 “Regulation on the Classification of Education in Latvia”, and also indicates the content of the programme and the programme’s affiliation to the thematic field of education “Engineering and Technology”.

The aim of the Bachelor’s programme “Computer Engineering and Electronics”, as well as the study results obtained during the study, correspond to the seven level of the Latvian Education Classification (the Cabinet of Ministers Regulation No. 322 “Regulations on the Latvian Education Classification”).

The defined tasks of the study program are aimed at achieving the program's aim: " to provide undergraduate education in Computer Science and Electronics, which forms graduates’ competencies necessary for successful professional activity and knowledge development in the fields corresponding to the specialisations of the study programme: Embedded Electronic Systems, Industrial Electronics, Telecommunications Systems and Computer Networks."

The achievable study outcomes of the study programme are formulated using a student centred approach, defining in a structured and detailed manner the knowledge, skills, competences that the student possesses and which the student is able to use and implement after graduation.

After completing the "Computer Engineering and Electronics" program, the graduate is able to use the acquired theoretical knowledge in electronics and computer science to solve practical problems in areas corresponding to the specializations of the "Computer Engineering and Electronics" program (embedded electronic systems, industrial electronics, telecommunications). and computer networks), able to work effectively independently and in teams with minimal supervision to perform design and production tasks in the areas of specialization of the program, as well as able to constantly improve professional skills by analyzing the features of electronic development. engineering, computer science, embedded electronic systems, industrial electronics, telecommunication technology and computer network technology.

The mapping of the study course (Annex 3.3.) for the achievement of the outcomes of the study programme allowed implementation of an in-depth analysis and specification of the achievable outcomes of individual study courses.

The admission requirements are determined in the TTI Admission Regulations and are based on the following normative acts: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the Cabinet of Ministers Regulation No. 846 of October 10, 2006 “On Requirements, Criteria and Procedures for Admission to Study Programmes”. A student who has passed the secondary school leaving certificate, who demonstrates proficiency in the national language and in a foreign language and in Mathematics (e.g. by successfully passing the centralised examinations) is eligible to study in a higher education programme.

The study programme is implemented in Latvian and English. For studies in English, applicants are matriculated on the basis of the results of the CE certificate in English, a test score of at least B2 level from an internationally recognised testing institution or the TTI entrance examination in English (only for those who have completed secondary education in Latvia).

Foreign applicants are matriculated on the basis of the results of an internationally recognised testing institution test in English at least at level B2 or a TTI entrance examination in English at least at level B2, except in cases where the previous education was obtained in English, and an entrance examination in Mathematics and Physics

The amount of study programme implementation is 160 CP, the duration of implementation in full-time studies is 4 years, in part-time studies - 5 years. Such size and duration of the programme is optimal for learning the study programme, because the amount of study courses for each specialization of the programme is 36 credit points, which corresponds to two full-time study semesters or more than two part-time study semesters

The study courses of each specialization in the amount of 36 credit points allow the graduate of the programme to gain in-depth knowledge and develop practical skills in the field of embedded electronic systems or industrial electronics, or telecommunications systems and computer networks and become a competitive specialist in the relevant production sector.

Such preparation of applicants for previous education, motivation for higher education and the organization of the TSI educational process can ensure the achievement of learning outcomes in the program "Computer Engineering and Electronics", and after the end of the program the award of an academic bachelor's degree.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The undergraduate educational program contributes to the development of the graduate's competencies necessary for successful professional activity in areas corresponding to the specializations of the educational program: embedded electronic systems, industrial electronics, telecommunication systems and computer networks. The program considers specializations from the point of view of integrating the fields of electronic engineering and computer science, which meet the modern requirements of the developed devices for embedded electronics, industrial automation devices, as well as telecommunication systems and computer networks. All three specializations of the program correspond to one of the information and communication technology specializations of the Latvian Smart Specialization Strategy (RIS3).

Since 2010, the production of electrical and optical equipment has been the fastest growing sector of the manufacturing industry in Latvia, the share of which in the total output of the manufacturing industry has increased from 3.7% in 2009 to 8.5% in 2021, when almost 90% of all products produced in the sector was exported.

In the informative report of the Ministry of Economy of the Republic of Latvia on medium- and long-term forecasts of the labour market, it is stated that “By 2040 the demand for labour will continue to shift in favor of the demand for specialists with higher education”. Similarly, a more pronounced insufficiency will be observed for specialists with professional education. By 2027, the gap between labour demand and supply of specialists with higher education could increase to 37 thousand professionals. The demand and supply of education in the “Engineering and Technologies" sector in 2030 is estimated to be 21% (Balance of demand and supply of workforce with higher education, https://prognozes.em.gov.lv/lv/darbaspeka-sabalansetiba, only in Latvian) - Supply - 174212, Demand - 211198, Shortage - 36896.

The projected labor surplus/shortage and number of graduates in the STEM field (supply and demand gap in 2027, number of graduates in 2019) is 2,850 graduates and -14,000 labor shortage (CSB data for 2019. EM forecasts for 2027).

Bachelor's programs related to electronic engineering and computer science are implemented in three Latvian universities, but the analysis of the available descriptions of these programs shows that the programs are implemented without integrating the fields of electronic engineering and computer science. The proposed undergraduate program includes study courses in the field of electronic engineering and computer science, which determine the basic knowledge in three specializations and form competencies corresponding to the specializations for the entire period of study.

In contrast to Latvia, the Computer Engineering study program at the bachelor's level is implemented at 2 universities in other Baltic countries. These programs provide integration of electronic engineering and computer science to varying degrees, as they are focused on study specialists either exclusively in the field of embedded electronic systems, or with closely related specializations.

Vilnius Technical University Gediminas (Lithuania) " Computer Engineering " offers two specializations: embedded electronic systems and computer systems, which are distinguished by a small number of electronic engineering courses. This program is conducted in national and English languages. The University of Tartu (Estonia) has a bachelor's degree program "Computer Engineering", which provides education only in the field of embedded robotics and only in Estonian

A characteristic feature of the "Computer engineering" bachelor's programs of both the universities of Latvia and the universities of the two other Baltic states is that they do not offer students special knowledge and do not develop competencies in the field of applied electronics. in the field of telecommunications systems and in the field of computer networks. TSI's Bachelor's study program "Computer Engineering and Electronics" differs significantly from these programs with a much wider integration of electronic engineering and computer science, as well as with three specialties that are based on this integration.

Taking into account the directions of modernization of the educational program and the fact that the specializations of the "Computer engineering and electronics" program are determined by agreement with specialists from companies that develop embedded electronic systems for various purposes and automated control systems for industrial production, as well as with specialists from companies in the telecommunications industry and computer network technologies , we can conclude that:

- the academic bachelor's study program "Computer engineering and electronics" meets the needs of both Latvia's Smart Specialization Strategy (RIS3) and the national economy;
- the analysis of the development plans of the Republic of Latvia, economic and societal needs clearly indicates the need to prepare specialists in the specializations of this study program;
- the professional and practical competences of the graduates of the program allow them to be competitive in the labor market both in Latvia and in the countries of the European Union;
- in the coming years, this TSI "Computer Engineering and Electronics" program can make a significant contribution to the development and modernization of industry in Latvia and the entire Baltic Sea region.

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the

students. The analysis shall be broken down into different study forms, types, and languages.

Bachelor study program "Computer engineering and electronics" (previous name "Bachelor of engineering in electronics") licensed and accredited full-time in person and part-time in absentia in Latvian, Russian and English languages.

The graphs presented in the appendix show a decreasing trend in the number of students in all study types and forms, with an increase in the number of students studying in English. The same trend of decrease in the number of students can also be observed in the 2 closing programs, so it is only natural that only one electronics direction program with relevant specializations is maintained.

The total decrease in the number of students from the 2019/2020 academic year is related to the June 21, 2018 and April 18, 2021 amendments to the Law on Universities of the Republic of Lithuania, which stipulates that universities whose language of study programs does not comply with Article 56 of this law under the conditions of the third part, have the right to continue the implementation of study programs in the relevant language until December 31, 2025. After January 1, 2019, the admission of students to study programs with an implementation language that does not meet the conditions of the third part of Article 56 of this law is not allowed. Thus, in the year 2019/2020, students were no longer accepted for studies in Russian at TSI, which caused a decrease in the total number of students and the number of foreign students.

Until now, students from foreign countries were admitted to study in English and Russian, and many foreigners, mostly from former post-Soviet countries, took the opportunity to study in Russian. 2022/2023 is the last year when the study program is conducted in Russian. Students have been informed about this, and if for some reason the program is not completed, students will be offered the opportunity to continue their studies in Latvian or English.

Distribution of foreign students by host country 2021/2022. this year: 3 from Uzbekistan, one each from Azerbaijan, Kazakhstan, Kyrgyzstan. Also in previous years, students were mainly from these Central Asian countries.

The 2020/2021 admission results were, in turn, affected by the restrictions imposed worldwide as a result of the Covid-19 pandemic, especially the number of foreign students in the program.

As a private educational institution at TSI, studies are only fee-based. Similar types of electronics and telecommunications programs are implemented by Riga Technical University, where state budget study places are available for students. This proves the constant and stable interest in the TSI study program and the relevance of the program itself, taking into account the impact of the ICT industry on the national economy.

Currently, in recent years, the program has been graduated by students who entered when the total number of students was high.

The dropout rate is around 15% every year, it is higher among foreign students. Statistical data show that students leave their studies due to failure (for foreign students this is the main reason) or due to tuition debt, or in some cases by choice. In such situations, the head of the study program meets with the student to find out a more precise reason. Often these are private considerations that are not related to the quality of the study program.

The most important and serious reason is the difficulty or impossibility of combining studies and work in the senior years of the program, because after the 5th or 6th semester, students of the program are in demand on the labor market: in transport companies, companies engaged in the development and production of electronic devices, companies with automated production, etc. .

In order to promote students' interest in TSI curriculum specializations, the robotics and electronics club is constantly active, except during the COVID-19 quarantine months. In the robotics and electronics group, engineers from the Faculty of Engineering and TERC teach 4 academic hours once a week. Students over the age of 15 are introduced to the components of electronic devices and their construction using Arduino learning kits.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study program has been developed pursuant to Regulation No. 240 of the Cabinet of Ministers of 13 May 2014 on the National Academic Education Standard, the compliance can be seen in Appendix 3.2.

The study direction and the study programs included in it have been developed taking into account the mutual connection and sequence of study courses. This enables to achieve the goal of the study program and provide a set of knowledge, skills and competences in accordance Level 6 of the European Qualifications Framework of Latvian Education Classification.

In order to ensure the attainment of the aim of the study program, the study program contains nine elements of knowledge, skills and competencies to be acquired. Considering the achievement of learning outcomes, there have been identified specific study courses and the amount of knowledge, skills and competencies to be acquired (see the mapping of the study program in Appendix 3.3.).

The program has three specializations: "Embedded Electronics Systems", "Industrial Electronics", and "Telecommunications Systems and Computer Networks", each of which contains compulsory general education and industry theoretical courses and study courses in information technologies in the amount of 74 CP (Part A), compulsory industry professional study courses and the choice of professional specialization courses in the amount of 70 CP (part B) and free choice courses (block C) in the amount of 6 CP.

Programme specializations in full-time studies begin in the 5th semester, in part-time studies begin in the 6th semester. The specializations of the programme are learned in the form of modules, the volume of each specialization is 36 CP. Specialization courses are planned for the 3rd and 4th year of study, after students have completed most of the basic study courses of block A and B. CPs of specialization courses are divided by semester as follows: 5th semester - 4 CP, 6th semester - 12 CP, 7th semester - 12 CP, 8th semester - 4 CP. The set of study courses of each specialization allows to achieve the specific study results of the specialization of the programme.

Program specializations in full-time studies begin in the 5th semester, in part-time studies begin in the 6th semester. Specialization "Embedded electronic systems" is focused on researching the principles of construction and development of electronic systems and devices using microcontrollers and microcomputers. This specialization requires a combination of electronic engineering and computer science. Therefore, the study plan of the specialization "Embedded Electronic Systems" includes study courses related to electronic engineering: Data structures and algorithms, Software Engineering, Operating Systems and System Programming, Digital Processing of Signals, Embedded Systems Design Fundamentals, Digital Units Computer Projecting, Electronic Design Automation, Microcomputer Embedded Systems, Internet of Things Engineering andCybersecurity, which in general allows to achieve the specific study result: students know and know how to use the principles of integrating electronics, processor devices and software applications and are able to design embedded electronic devices and systems using microcontrollers and microcomputers.

Specialization "Industrial electronics" is focused on improving students' competencies necessary for professional activity related to industrial and transport automation. Therefore, the program of this specialization includes study courses that ensure the development of principles and methods of industrial automation systems based on programmable logic controllers using computer design tools: Analogues Electronics, Electronic Sensors and Actuators, Programmable Logic Controllers and Their Programming, Design of Automated Systems, Power Electronics, Electronic Design Automation, Control Programs Design for Industrial Robots, Development of Automated Industrial Systems, Automation of Building Engineering Systems. These specialized study courses enable the achievement of the study result of the program: students are able to design industrial electronics systems and devices, develop process control programs and perform maintenance of industrial automation systems.

The specialization "Telecommunications systems and computer networks" is focused on learning the principles of construction, operation and software of modern information transmission systems. Therefore, the study plan of the specialization "Telecommunications systems and computer networks" includes study courses in both electronic engineering and computer science: Web programmēšana, Operating Systems and System Programming, Computer networks-2, Wireless Communications, Digital Processing of Signals, Digital Telecommunication Systems Technologies, Mobile and Satellite Telecommunication Systems, Internet of Things Engineering

Cybersecurity. These study courses allow to achieve the specific study result: knowledge and ability to use organizational principles, design methods and maintenance methods for telecommunications systems and computer networks.

The compulsory study courses of the program provide general knowledge in computer engineering, computer science and electronics. The program is academic, so its structure includes a study course that develops research skills: Introduction to scientific research.

The study programme offers free choice study courses (part C), from which 6 credit points must be obtained to fulfill the programme requirements. The purpose of these study courses is to provide students with the opportunity to acquire additional knowledge in a field of science or to acquire skills useful for professional activity. Several free choice study courses are offered each year, such as Philosophy, Digital Marketing, etc. In addition to the study courses offered in the programme, the TSI students have the opportunity to choose the study courses from Part A or Part B of other study programmes as Block C courses, by matching them in the Study Department with their list of classes. Block C also offers new study courses developed by the lecturers in the field of study of the programme. After the completion of such courses, student feedback is collected on how interesting and useful the course was, and if the feedback is positive, the study course is included as an independent course in Part B of the programme. For example, starting from 2018, the faculty offered the free choice course “Chatbot development and design”, from 2021 - "Economics of artificial intelligence".

The study programme also includes the content requirements of the study courses specified in the Law on Environmental Protection and the Law on Civil Protection (Occupational Safety, Civil and Environmental Protection - 2 CP).

The foundation of the quality assurance of the study program is cooperation with potential employers, organization of meetings for the discussion of issues related to the current issues on the labor market, demands of the labor market, reviewing annual self-assessment reports, receiving and reviewing suggestions from the Study Council. The relevance of a course of study is also ensured by the proportion of faculty members recruited from the industry who are elected to the academic positions at TTI or are invited to teach individual courses, and their vision of the trends in the development of the subject matter of the relevant course of study in computer science. The correspondence of the study course content to the development trends in the field and science is also facilitated by the active practical, scientific and research activity of the programme academic staff - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities.

Study course, incl. the content of the course descriptions and its relevance are reviewed every year during the annual self-evaluation of study programs and study directions in the months of December - January, in accordance with the Study Course Management Regulations. As a result of the self-assessment, a program development plan is developed, which includes the study course, incl. the necessary updating of study course descriptions according to the development trends of the industry, labor market and science. Student feedback is taken into account in the study course evaluation questionnaire and the opinion of graduates and employers, who provide input in relation to the latest developments and current trends in the labor market. Once or twice during the academic year, there are round table discussions with employers and graduates, who will often become employers themselves after their studies.

Evaluating the link between the goal and the achievable results of the study program with the goals and results of the study courses, it can be concluded that the content of the program and study courses allows to achieve the overall goal of the program and study results. The content of the study courses included in the program is current and meets the needs of the industry, the labor market and scientific trends. By successfully completing the program, students achieve the expected results of the program, acquire knowledge, skills and competence that are in high demand in the labor market.

3.2.2. In the case of master’s and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and

findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study implementation methods, assessment methods, types and requirements are included in the description of each course available to students in the e-learning environment Moodle.

The study process is mainly implemented in the format of interactive lectures, seminars, workshops and student independent work. Courses include workshops, often discussions, role-plays, teamwork, project work, in-basket professional tasks or solving specific practical problems. The choice of a method depends on the learning outcomes that a lecturer is planning to achieve. The applied methods are geared to the development of the students' abilities, specifically, to learning, creative use of knowledge, cooperatation, self-evaluation, offering of alternative solutions to problems, to critical thinking and making responsible decisions.

The program is taught full-time in person and part-time in absentia (studies are organized on Saturdays).

The basic principles and procedure for the assessment of the acquisition of the study program comply with the requirements of Article 40 of the National Academic Education Standard. Pursuant to the regulations adopted by the TTI Senate, the results of the academic Bachelor's study program are evaluated according to two evaluation criteria: a quality criterion based on the 10-point marking system and a quantitative criterion - a credit point based on the total number of hours in the course. Studiju kursu rezultātu novērtēšanā pielieto komplekso metodi. The complex method is used to assess the results of study courses. It includes assessment of students' practical work, individual or group work, mid-term assessment and final examinations (a test or exam). In order to facilitate students' independent work, it is stipulated that the final assessment (a test or exam) should not exceed 50% of the final mark for the course. In the beginning of a semester, students are informed about the components of the final mark and their assessment.

In practice, the evaluation process takes place regularly throughout the course of studies. The final assessment of students' learning outcomes is completed at the end of a semester after all stages of assessment are completed, such as practical assignments, seminars, independent work, mid-term assessment and examination. Teaching staff develop an assessment methodology, which indicates the percentage of each assessment criterion in the composition of the total mark.

The purpose of laboratory classes is deepening and consolidation of theoretical knowledge, teaching students methods of experimental and scientific research, creation of scientific analyzes and generalizations of obtained results, skills in working with laboratory equipment, technical means, control-measuring devices, means of debugging control programs. After completing laboratory work, students present a report and defend it.

An integral part of the educational process is work with autonomous and industrial robots, electronic equipment, built-in robot control systems, computer and model programs, special attention is paid to internships in TSI "Industrial Robots" and "Mobile Robots" laboratories. that gives invaluable practical experience

Students' independent studies play an important role. The description of their progress is included in the description of the study course as a mandatory component. Students' ability to learn independently is purposefully developed in all study courses. Students acquire research work skills by regularly working with literature and Internet resources in order to successfully develop various coursework and bachelor's thesis. Thus, students' scientific research work, work with the international scientific databases available in the TTI library is promoted.

The programme specialization "Embedded Electronic Systems" contains study courses related to electronics engineering in the amount of 20 CP ("Fundamentals of Embedded Systems Design", "Computer Design of Digital Equipment", "Computer Design in the EDA Environment", "Microcomputer Embedded Systems" and "Internet of Things Engineering "), as well as computer science study courses in the amount of 16 CP ("Data Structures and Algorithms", "Software Engineering", "Operating System and System Programming" and "Cybersecurity"). Study courses of the first group allow students to acquire competences in hardware development of embedded electronic systems, while computer science study courses develop competences in control of embedded electronic systems processor devices and development of applications. Students use the theoretical knowledge acquired during the lectures of the specialization course in practical and laboratory classes:

- developing algorithms and program codes for control and applications using special programming environments;
- for control and application testing using debug suites;
- for design, simulation and prototyping of embedded electronic systems.

The software and equipment of three laboratories are used for practical and laboratory classes: "Laboratory of embedded computer systems and digital signal processing", "Laboratory of computer modeling of electronic systems" and "Laboratory of design and prototyping".

The specialization "Industrial electronics" includes study courses of two groups:

- study courses in the amount of 20 CP ("Analog Devices", "Sensors and Actuators of Automated Systems", "Power Electronics", "Programmable Logic Controllers and their Programming" and "Computer Design in the EDA Environment"), in which electronic devices used in automated industrial systems are learned construction, operation and design principles.
- study courses in the amount of 16 KP ("Automated system design", "Automated Industrial systems development", "Building Engineering Systems Automation", "Industrial Robot Control Program Design"), in which the principles of automated industrial system design are learned.

Study courses of the first group provide students with theoretical knowledge of electronic analog devices, electronic sensors, electric machines, programmable logic controllers and power electronics devices, and during laboratory classes develop practical skills in the design and use of electronic devices based on these electronic components. The courses of the second group develop students' competences, which are necessary for the professional design of automated industrial systems of various importance. The software and equipment of four laboratories are used for the practical and laboratory lessons of the specialization "Industrial Electronics" study courses: "Electronics Laboratory", "Electronic Systems Computer Modeling Laboratory", "Designing and Prototyping Laboratory" and "Industrial Automation Laboratory".

Specialization "Telecommunications systems and computer networks" also includes study courses of two groups:

- study courses in the amount of 12 credits ("Wireless Communications", "Technologies of Digital Telecommunications Systems", "Mobile and Satellite Telecommunications Systems" and "Digital Processing of Signals"), in which the structure, operation and design principles of telecommunications systems are learned.
- study courses in the amount of 24 CP ("Computer Networks - 2", "Internet of Things Engineering", "Operating System and System Programming", "Cyber Security" and "Web programming"), in which the principles of computer network design and administration are learned.

Specialization courses allow students to acquire theoretical knowledge and practical skills in two scientific and technical areas of specialization. The software and equipment of four laboratories are used for the practical and laboratory lessons of the specialization "Telecommunications Systems and Computer Networks" study courses: "Laboratory of Telecommunications and Electronic Optical Systems", "Computer Network Technology Laboratory", "Cisco Academy" and "Laboratory of Embedded Computer Systems and Digital Signal Processing".

During the study process, in accordance with the study program, the student must prepare a coursework for part B of the study course "Processor equipment programming", a coursework, a coursework corresponding to the study specialization and a group project. Within the specializations, students prepare coursework in the following training courses: "Fundamentals of embedded systems design" (specialization "Embedded electronic systems"), "Programmable logic control and their programming" (specialization "Industrial electronics") and Computer networks - 2 (specialization "Telecommunication systems and computer networks").

Coursework is necessary for the successful acquisition of knowledge and skills. The development of course works gives students the opportunity to work independently with the offered scientific literature and to apply the knowledge gained in the lectures practically. During the course work Programming of processor devices, the student develops the algorithm of the given processor device according to the individual task, performs the software implementation of the developed algorithm and tests the implemented control program using the given processor device. During the course work within the specialization subject, the student develops the structural, functional and circuit diagram of the device or system to be developed, their working algorithm, implements the developed algorithm and tests the implemented program according to the individual task.

When performing a group project, special attention is paid to the collective work of students: at the first lesson, the teacher issues a task, and project groups of 2-3 students are formed by analogy with robotic companies. Students learn to work in a team, which is especially important in the complex robotics industry. It requires students to intensively study the literature and develop practical work, active and analytical participation in discussions. Group design ends with the joint preparation of the final report, the preparation of a presentation and the defense of the achieved overall and individual design results.

At the end of the Bachelor's studies, students choose a theme for their Bachelor’s thesis and in cooperation with their supervisors write and defend it.

The study methods used in the study programme contribute to the achievement of the course and programme goals and learning outcomes, provide student - centred education to encourage students to take an active part in the learning process and to ensure the appropriate assessment of students' performance.

The principles of student - centred education and an individual approach to students are provided in the study programme:

- Learning outcomes. The evaluations of the study courses of the programme and the number of credit points are related to the learning outcomes. Students are informed about the results of each study course. The lecturers relate the results of the course to the results of the study programme, and also argue the necessity of studying the specific courses in order to become a computer science specialist in software engineering or artificial intelligence;
- Students are involved in the improvement of the content of the study programmes and study process through the students' surveys, as well as through involvement in the collegiate bodies of TTI and the Student Self-Government. Therefore, the students are provided with the opportunity to influence their own study process. Student representation in collegiate bodies is discussed in criterion 1.2 of the study field, the results of the student survey are shown in Appendix 7.
- Access to education and personalization of studies. When students study in the programme, a flexible study process is provided - various forms of study (on-site full time, part time, distance learning), the opportunity to create an individual study plan, which gives students the opportunity to combine work with studies already from the second year. Also, students of the day department have the opportunity to change the form of studying to part-time studies or distance learning in order to combine studies and work. Access to education is ensured by a digitized study process (e-library), discounts, social support (for foreign students, students who come to the university as part of mobility).
- Development of academic staff competencies. Pedagogical methods, study course structure and evaluation methods are chosen by the teaching staff responsible for the study course, according to the specification of the course content and programme, as well as the needs of the students. Courses and seminars on the latest teaching and pedagogical methods are organised for academic staff, as well as the attendance of qualification improvement courses is encouraged, both at internal faculty events, at the level of TTI, and internationally. More details are in the description of criterion 2.3.6 of the study field.
- Students receive feedback, which usually provides advice on the learning process and on ways to improve their learning and research skills.
- In the organization of research work (in the selection of topics of study projects and final theses), the field of interest of the students, the specificity of the practical work and experience are respected.
- Assessment is consistent, applied equally to all students and is carried out in accordance with the approved procedures, and learning outcomes are assessed in accordance with the Regulations on the Charter of Studies. The assessment criteria for each course of study must be communicated to the students by the teaching staff in the first lecture, and they are published in the TTI e-study environment. The description of each course specifies the connection of the study course evaluation criteria and methods with the learning outcomes of the study course, as well as specified conditions for taking exams. (See Appendix 3.5, descriptions of the study courses of the Bachelor study programme "Computer Engineering and Electronics")
- Procedures for examining the student appeals are in place and have been communicated to the students.
- Admission procedures and criteria are open. Admission rules with a detailed description of each programme are published on the TTI website in Latvian and in English.
- An information system has been created to ensure that the students can progress in their

studies. More details are available in the description of criterion 2.3.4 of the study field.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

Students choose themes of their Bachelor's theses independently from the list of research directions for Bachelor's theses offered by the Faculty. The offered themes are broad and comprehensive. Together with the supervisor of the final Bachelor’s thesis, a student can make corrections and specify the theme. The student can also propose his or her own research theme. This is usually the case when the student is already working and the chosen research topic will help him or her to acquire professional competences in a specific field.

The list of possible research areas offered by the Faculty is updated annually, taking into account the development trends in ICT and global trends in economics, politics and society, which affect the needs of the labor market and create new requirements for the education of modern aviation professionals.

Appendix 3.8 provides a list of examples of bachelor thesis topics that were defended in recent years. Taking into account the small number of graduates of the academic bachelor's program "Electronics", which is being transformed into the academic bachelor's program " Computer Engineering and electronics", the topics of the final theses of the closing professional program Electronics are also indicated in the appendix 3.8.

The final theses of the students of these programms are relevant both to the company in question and to the industry as a whole. The sample themes of bachelor's theses and diploma projects are developed on the basis of both the experience of teachers and the recommendations of employers.

Īpaša praktiska nozīme ir studentu darbiem, kas izstrādāti sadarbībā ar rūpniecības, telekomunikāciju vai transporta uzņēmumiem (LDZ tehniskās nodaļas, Rīgas satiksmes tehniskās nodaļas, Latvijas gaisa satiksmes tehniskās nodaļas, Tele2 un LMT tehniskās nodaļas, Latvijas Gāzelain tehniskās nodaļas, SIA, S „Robologic” utt.). Tie sniedz studentiem iespēju iedziļināties uzņēmumu aktuālajās problēmās un meklēt iespējamos risinājumus reālos apstākļos. Tā kā elektroniskās transporta sistēmas un automatizētās vadības sistēmas rūpnieciskajai ražošanai attīstās dinamiski, tāda pieeja ir liela priekšrocība studentiem.

Of particular practical importance are student works developed in cooperation with industrial, telecommunications or transport companies (LDZ technical departments, Riga traffic technical departments, Latvian air traffic technical departments, Tele2 and LMT technical departments, Latvian Gāzelain technical departments, SIA "Robologic" etc.). They give students the opportunity to delve into the current problems of companies and look for possible solutions in real conditions. Since electronic transport systems and automated control systems for industrial production are developing dynamically, such an approach is a great advantage for students.

The final exam papers of the program are evaluated by a panel, which also includes industry professionals, and which evaluates both the relevance of the paper and the student's knowledge and presentation skills. As part of the bachelor's examination commission, the chairmen of the commissions are representatives of employers.

The assessment s of the final theses are different, but this indicates not only the level of knowledge, but also the ability to concentrate when speaking in front of the public, the ability to argue, motivate and defend one's opinion and proposals.

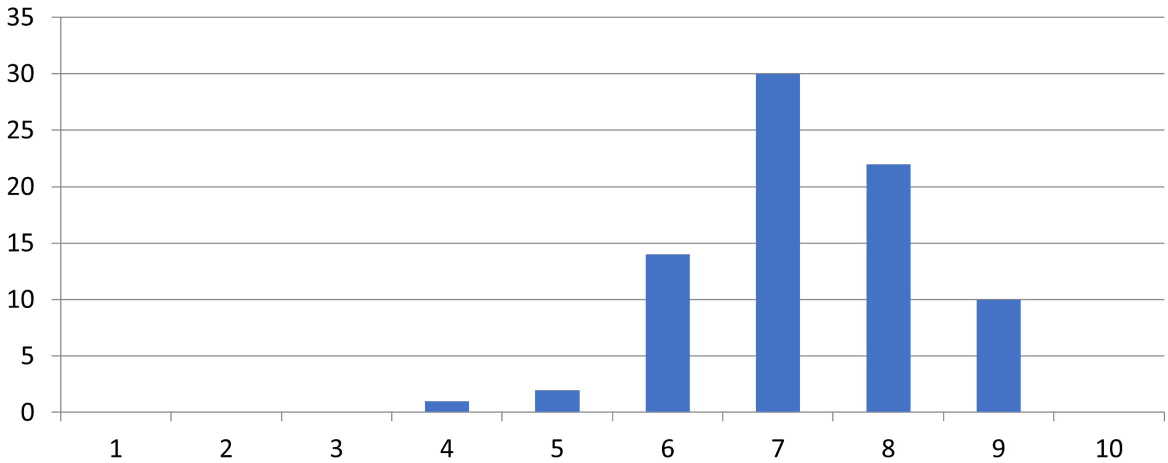


Fig.1. Assessments of bachelor's and diploma thesis during the reporting period

As can be seen in the evaluations of bachelor's theses in the reporting period (Fig. x), most final theses have been evaluated in the range from 7 (good) to 9 (excellent), which makes up 78% of all defended bachelor's theses, of which 10 theses were rated "excellent", "very good" - 22 works, "good" - 30 final works. 18% of students received a rating of 6 (almost good), while 4% of students received a rating of 5 (satisfactory) and 4 (almost satisfactory). The positive evaluations of bachelor theses and diploma theses indicate the high scientific quality of bachelor theses and diploma theses, the ability to convincingly and argumentatively defend the research results, as well as the preparation and suitability of graduates for the labor market. The highest grade "excellent" is given only for excellent performance, and if the student has presented at an international or national conference, prepared a scientific publication or the like. During the reporting period, no final thesis in the bachelor's program was rated "excellent". This only confirms the serious attitude of the final examination commission when evaluating the performance of each student. Also, no unsatisfactory rating has been received.

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

In the study direction report in sections 2.3.2. - 2.3.4 the full information on these issues is provided. In this paragraph there is only additional, separately highlighted and emphasised additional information on the study programme.

The study process is mainly provided by the staff of the Faculty of Engineering of TTI. In addition to that, the staff of the Faculty of Transport and Management Sciences are involved in the humanities and social studies courses.

The Faculty of Engineering of TTI provides teaching and methodological work: creates and updates study course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and provides defences of bachelor theses and carries out other activities related to teaching, methodological and scientific work. The Digitisation and Innovation Learning Centre is responsible for the development and deployment of teaching methodological materials for distance learning study courses on the TTI Learning Management System platforms.

In order to provide students with practical experience, TTI laboratories are intensively used during studies. Practical and laboratory work is carried out in the laboratories, and the laboratories are also available to students outside of study time. During their studies, students of the "Computer Engineering and Electronics" program can use the equipment and facilities of 11 TERC laboratories, which ensure the implementation of the training program. TERC laboratories provide students with the opportunity to participate in TTI internal projects, developing electronic devices for internal events such as robotics tournaments, Science Night, Open House, exhibitions, etc. Students of the program conduct research and development of electronic devices in coursework, undergraduate theses and theses.

Students also have the opportunity to get involved in the activity of research clusters and implement projects that are more focused on research and development, for example, in 2022, three students of the professional program Electronics completed the development of an electronic 3D scanning system using TERC laboratory equipment and software as part of the Idea Hub project. Information about the opportunity to participate in projects or other activities is distributed both on the TTI website and by involving students individually, taking into account their desire to gain practical experience.

Starting from November 2020, in TERC laboratories, the event "Work requires skill development" is implemented for students under the ESF project "Support for the education of the unemployed" No. 7.1.1.0/15/I/001. Three students of the "Electronics" professional program completed additional practice on TERC laboratory equipment. As a result, they were hired by SIA "Robologic" before completing their studies in the "Electronics" program.

The common study, scientific, informational (including library), material-technical and financial base of TTI and the Faculty of Engineering creates prerequisites for the achievement of study results and indicates the possibility to ensure a high - quality study process for the study programme " Computer Engineering and Electronics". For the effective implementation of the study programme, the academic staff and students at the faculty have access to the auditoriums equipped with the latest generation of visual and audio equipment, as well as highly certified and evaluated laboratories, which correspond to the specifics of the study programme and the conditions for its implementation.

In the reporting period, for the needs of the study field, TTI has acquired infrastructure for laboratories, practical classes (e.g. modelling computer programmes) and lectures (e.g. scientific literature, databases of scientific articles), computer equipment (monitors, computers, presentation lasers), laboratory equipment (for details, see Appendix 9. Laboratories of the study field).

The TTI library is available for use by students of the "Computer Science£ study programme. In 2019, as part of the STEM project, around 3000 new books were purchased for a total amount of EUR 10 000 for needs of the direction from various scientific publishers. For example: Springer, Tailor&Francis, Elsevier, etc. 90% of these books were purchased in electronic format and are available to users via the library electronic catalogue. In the following years, the collection of the library was supplemented with newer books relevant to the field. The library has 29 890 documents available for the students of TTI, of which the following are specific to the field: books - 14 146, e-books - 2588, periodicals -1072; and the following databases are subscribed to: the Academic Complete e-book database, where the number of books in the field of Computer Sciences has 7075 titles. The availability of e-literature is particularly important for distance learning students.

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the moment when the programme was founded, income from the tuition fees has been the main source of funding for the study process. The study programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee per full-time student is EUR 2200 per year, per part-time student - EUR 1760 per year, distance learning - EUR 1500 per year. The amount of tuition fees for each academic year shall be determined and approved by an order of the Rector. The tuition fee payment procedure is laid down in the Regulation on the tuition fee payment procedure, which provides for the possibility to pay the tuition fees for the entire study programme as a whole, for one academic year, for one academic semester or as a monthly payment (starting from the 2nd semester).

See Appendix 3.7 for average costs. There is no difference in the cost of studying in Latvian and English, since the studies are delivered at a high quality level without a breakdown by language of study, so there are no different tuition fees.

The cost structure of the study programme in the last academic year 2021/2022 includes salaries and taxes (including costs of scientific publications, etc.) (including the payment of the costs of publications and other similar costs, in accordance with the TTI academic staff remuneration regulations) in the amount of 56%, study programme development and implementation costs in the amount of 5%, teaching materials and other similar costs in the amount of 9%, scientific infrastructure costs and other similar costs amounting to 12% of the volume, advertising and marketing costs amounting to 2% of the volume, infrastructure costs (including IT costs) amounting to 9% of the volume, depreciation and amortisation 5%, other administrative costs 2%.

Every year TTI offers to the students the opportunity to receive personalised discounts of 50%, 75% and 100% on full-time tuition fees, which are awarded on a competitive basis. Applicants are evaluated on the basis of the results of the national centralised examinations, the average grade of the certificate, motivation and other additional achievements. Students have the opportunity to obtain scholarships from companies

In order to be profitable, the programme must have at least 10 students. It is taken into account that the study programmes of the field of the study respect the continuity of the study courses, as well as the study plans of each programme are mutually coordinated - the courses included in the plan and their sequence by semesters. There are general education courses such as Occupational Safety, Civil and Environmental Protection, Higher Mathematics, Foreign Language, or Programming, but there are courses such as Computer and Computer Systems Architecture, which are taught in the 1st and in the 2nd semesters of the “Computer Science” programme in the amount of 8 CP, while in the Computer Engineering and Electronics programmes they are taught only in the 1st semester in the amount of 4 CP, and so on. Another example is when the study course is taught in two study programs "Computer engineering and electronics" and "Robotics": Physics, Electric circuit theory, Microcontroller programming, Automatic control theory, etc.

Group of 10 students is given as the average number. As already mentioned, several courses are taught jointly for different programmes. In full-time face-to-face studies, the costs are higher, therefore a larger number of students is needed - 12, in part-time studies - 8. The language of study does not affect the amount of costs.

This procedure saves money and makes the programmes cost-effective even with fewer students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the

learning outcomes.

The teaching of the study programme is provided by 29 members of academic staff with relevant academic experience and qualifications, and 22 of them are elected lecturers.

7 TSI professors are involved in the implementation of the mandatory and limited optional part of the academic bachelor's program "Computer Engineering and Electronics", including 6 with a doctorate in engineering: Dr.sc.ing. A. Grakovskis, Dr.sc.ing.I.Jackiva, Dr.habil.sc.ing.I.Kabaškins, Dr.sc.ing. B. Mishnevs, Dr.sc.ing., D.Pavlyuk (second doctoral degree in economics), Dr.sc.ing.I.Pticina and Dr.sc.administrator. J. Stukalina; and three associate professors Dr. sc.ing. A. Kraiņukovs, Dr. sc.ing. N. Spiridovska and Dr. administrator. I. Sproge. Therefore, it can be concluded that the qualifications of the teaching staff involved in the realization of the study program are fully in accordance with Article 55 of the Law of the Republic of Lithuania "Law on Higher Education". to part 1, which stipulates that no less than five professors and associate professors together, who have been elected to academic positions at the respective higher education institution, participate in the implementation of the compulsory and limited optional part of the academic study program.

In addition to the mentioned composition of professors, 7 assistant professors, 5 lecturers .

A total of 17 or 77% of the academic staff involved in the program have a doctorate in science - 15 a doctorate in engineering and 2 a doctorate in social sciences.

In the study process, not only the academic staff of the field of study are involved, but also several industry specialists, including foreign teaching staff, who with their professional experience not only deepen the students' practical knowledge and skills within the study course, but also increase the students' employment opportunities after graduating from the program.

Currently, only 4 of the elected teaching staff in the program work in industry companies: J. Revzina, SIA iPro cyber security engineer and Cisco Networking Academy instructor, S. Šarkovskis SIA Sonarworks, DSP Researcher.

In the study program, leading lecturers from other universities or specialists in the specific field of knowledge are additionally engaged, e.g. N. Šlendins, a lecturer at the National Defense Academy, teaches the course "Occupational safety, civil and environmental protection" for students of all streams.

Of the invited lecturers, 2 have a Doctor of Science degree, the rest have a Master's degree.

Some courses have several lecturers, or the main course is taught by the programme director, but it is already expected that that the representatives of the industry will be invited as guest lecturers for some topics, thus ensuring both the quality and relevance of the study course content.

In order to improve the quality of the programme, the lecturers deliver courses in one of the two languages only. Lecturers carry out scientific research and participate in the education of students. The Institute of Transport and Telecommunications ensures the professional development of its staff as far as possible and provides incentives with a remuneration, which is competitive in Latvia.

The knowledge of the state language by the academic staff involved in the programme complies with the Cabinet of Ministers' Regulation No. 733 of 07.07.2008 “Regulations on the scope of knowledge of the state language and the procedure for testing state language proficiency for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union, and the state fee for testing the knowledge of the state language”. The TTI Human Resources Department verifies the skills in the state language at the time of recruitment.

In order to be sure of the English language skills of the teaching staff, TTI periodically organises an English language proficiency test and, if necessary, additional training, for example, in the 2019/2020 academic year, several of the teaching staff improved their English proficiency level in courses organized within the framework of project 8.2.2.; repeated English language courses are planned from the university own funds in the future.

The qualifications of teaching staff involved in the implementation of the study program meet the conditions of the implementation of the study program and the requirements of regulatory acts, ensure the achievement of the goals and study results of the study program and corresponding study courses.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In the period since the previous accreditation in the academic year 2012/2013, changes have occurred in the composition of the academic staff involved in the implementation of the Master programme “Computer Engineering and Electronics”.

Position	2012 /2013 academic year			2021 /2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professors	4		4	7		7
Associate Professors	1		1	3		3
Assistant Professor	4	1	5	7		7
Lecturers		5	5		4	4
Assistants		1	1			
Guest lecturers	2	2	4	2	5	7
Total			20			30

An improved program with three specializations is submitted for evaluation, thus the total number of lecturers has increased. Of the 2021/2022 lecturers, only 8 were in the teaching program even during the previous accreditation. During the reporting period, new (elected TSI) lecturers were recruited into the program, who teach a specific study course or part of it. Of them, nine lecturers have a doctor's degree, three - professors, three - associate professors, three - assistant professors and 4 lecturers and one research assistant. Some of the teaching staff are graduates of different years of study programs, who now represent the companies of the industry V.Gredasovs, J. Chachik and I.Laksa.

Changes in the composition of lecturers are influenced by several factors. One of which is generational change, as many lecturers were in the pre-retirement age group at the time of the previous accreditation. Currently, many young lecturers (up to 45 years old) are teaching in the program. Several teaching staff have increased their academic work experience and have been elected to higher positions. Two of the lecturers of the last accreditation period have obtained a doctorate in science and hold the positions of professors: I. Pticina and J. Stukalina, or associate professor positions - A. Kraiņukovs. Among the teaching staff of the programme, O. Zervina, A. Vesjolijs, O. Skorobogatova are currently studying at a doctorate level.

The choice of teachers is determined by the content of the study program, which is continuously improved according to the rapid development of the ICT industry. The program includes study courses that ensure future competences, inviting teaching staff who specialize in the specific field, including from the professional environment, to teach these courses. For example, study courses related to artificial intelligence, which are taught by Accenture Latvia data scientist J. Kijonoka in bachelor's and master's computer science programs. J. Revzina teaches training courses related to computer technology and cyber security: "Computer networks -2" and "Cybersecurity", S. Šarkovskis teaches study courses dedicated to embedded systems and electronics: "Computer design of digital equipment" and "Electronics and microelectronics".

This makes it possible to ensure the connection of the programme with practical activities, since the information is obtained directly from the industry professionals, and generates more interest among students.

During the reporting period, the University made a concerted effort focused on the composition of the academic staff in order to ensure the quality of the study programmes in the best way. The human resources development plan of the faculty was elaborated, which provides for the improvement of the quality of study programmes by promoting the growth of the existing academic staff, attracting academic staff recognized in the academic environment, experts and professionals in the field, foreign guest lecturers, as well as students and graduates of the doctoral study programme of the university.

In general, it can be concluded that the changes in the structure of the academic staff involved in the study programme can be evaluated positively, that the relevant qualifications and experience of the academic staff in academic work ensure a high quality of education and that it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for mutual cooperation between academic staff, which promotes the development and interconnection of the study courses. The improvement of the study courses is carried out on a regular basis, based on suggestions made by students, industry development trends, and the latest results ofthe research, scientific activities and innovations.

During the implementation of the study courses and scientific work, regular meetings of teaching staff take place, in which they exchange experience on the study course topics, results of scientific work, new developments in the research, etc. Discussions are used to develop and improve the content of studies, with mutual agreement on topics, emphases, responsibilities and compliance with regulatory requirements.

The knowledge acquired in other study courses is taken into account in the design or development of the content of the study courses, indicating it as the required prior knowledge.

For example, in preparation for the programme evaluation, the content of the programme was reviewed and faculty members mutually agreed on the extension of some courses of study to reduce the number of small 2 CP courses in the programme as much as possible.

Taking into account that study programs are taught in several languages, and often in order to improve the quality, the same course is taught in Latvian and English by different teaching staff, in the process of harmonizing the study courses, in order to harmonize the topics to be learned during the lessons and ensure uniform requirements, everyone with the specific study is involved course related teaching staff. Thus, it is ensured that the topics covered within the study program are constantly improved and updated in close mutual cooperation.

In the faculty, there is cooperation between individual lecturers who read one study course together in order to coordinate the topics to be learned during the lessons and ensure common requirements, according to the course description and other current events. Thus, it is ensured that the topics covered within the study program are constantly improved and updated in close mutual cooperation. For example, assoc.prof. A. Kraiņukovs, in cooperation with lecturer I. Laks, teaches study courses Electronics and microelectronics, Sensors and actuators of automated systems, and Intelligent robots. Another example, prof. A. Grakovskis, in cooperation with lecturer I. Laksas, teaches the study courses Electric circuit theory and Optical fiber systems.

In recent years, teachers from the field of professional activity have been attached to the study program, who teach individual lessons in the existing study courses:

- S.Sharkovskis: Electronic devices in robotics and Robot control methods;
- V.Gredasovs: Industrial robots, Designing control programs for industrial robots and Robotization of industrial production;
- J. Chachik: Microcomputer embedded systems and Microcontroller programming.

Within the framework of the study program, cooperation with employers and professional organizations is carried out both in seminars, conferences, and also during personal contacts of lecturers, analyzing the competence of students and graduates, as well as solving questions about graduate employment opportunities in the future.

The connection with employers is also strengthened through the active participation of teaching staff in professional organizations and associations, the most important of which are the Latvian Information and Communication Technology Association (LIKTA), the Latvian Electrical Engineering and Electronics Industry Association (LETERA), the Mechanical Engineering and Metalworking Industry Association (MASOC)), Remotely Piloted Aircraft Association (LARPAS), Simulation Modeling Society, European Conference of Transport Research Institutes (ECTRI), Informatics Europe, etc.

As part of the study process, the preliminary defences are organised with the participation of a committee of faculty members, where the recommendations are collectively made to improve the bachelor theses. Consequently, mutual cooperation between lecturers of different fields is ensured and allows comprehensive recommendations for the development of bachelor's theses. The same cooperation is observed after the defence of the bachelor theses, when the Final Examination Board gives its evaluation as a result of the discussion, based on the evaluations proposed by the members of the Board. The committee is composed of leading faculty members, and the chair of the committee is a company representative.

Experienced researchers working at the Faculty of Engineering participate in the research projects and activities funded by the Latvian Council of Sciences, the European Commission and other international funding sources and foundations in cooperation with partners in universities and research institutions in Latvia, European Union Member States and worldwide: I.Kabashkin, I.Jackiva, M.Savrasovs, D.Pavlyuk.

The total number of lecturers involved in the implementation of the program is 29, while the total number of students on October 1, 2022 was 34, thus the ratio of students to lecturers is 1.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annev 3.6. Sample of the diploma.zip	3.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	Annex 3.10 Opinion of the Council of Higher Education.pdf	3.10.TSI_Bak datoru inženierija_250.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	3.1.pielikums. Statistika par studējošajiem parskata periodā.pdf	3.1.pielikums. Statistika par studējošajiem parskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 3.2. Compliance with the State Education Standard 3001.docx	3. 2. pielikums Atbilstiba izglitibas standartam CEE 3001.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 3.3. Mapping of the study courses 3001.xlsx	3.3.pielikums. Studiju kursu kartejums CEE 3001.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 3.4. The curriculum of the study programme.zip	3.4.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 3.5. Descriptions of the study courses modules.zip	3.5.pielikums. Studiju kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 3.9 Confirmation.pdf	3.9.pielikums. Apliecinajums atbilstiba AL.pdf

Management of Information Systems (45482)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Management of Information Systems*
Education classification code	*45482*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Mihails*
Surname of the study programme director	*Savrasovs*
E-mail of the study programme director	*Savrasovs.M@tsi.lv*
Title of the study programme director	*Dr.sc.ing.*
Phone of the study programme director	*29654003*
Goal of the study programme	*To provide students with knowledge and practical experience in using the latest ICT solutions to solve business problems in order to enhance business competitiveness and development, as well as to develop innovative and critical thinking and research methods*
Tasks of the study programme	*• giving students the opportunity to take part in scientific research; • to provide knowledge on the use of the latest ICT for solving business problems, its advantages, limitations and best practices; • to make full use of the world's literature in the acquisition of knowledge by providing a wide range of up-to-date literature on the organisation of ICT systems and their management and administration in the enterprise; • make extensive use of e-courses to allow access to lecture material, assignments, tests, contact with the lecturer and feedback from lecturers on progress; • attract industry professionals who are able to share their practical experience (by lecturing on individual topics, by lecturing on a whole course or by supervising the final project) to teach the courses; • to encourage research and analysis of business problems in Master's theses, learning about other countries' experience in solving similar problems, searching for and comparing possible alternatives and developing proposals based on the latest ICT*

Results of the study programme	*• Able to obtain and rationally examine the information and make reasoned decisions;* *• Able to organise and lead teamwork, take responsibility for team performance, demonstrate leadership skills and results-oriented thinking;* *• Able to conduct research in the IT domain, analyse data, state hypotheses, and make well-grounded conclusions and generalizations;* *• Able to explore and utilise current and emerging technologies for lifelong learning and professional development;* *• Able to explore and utilise current and emerging technologies for lifelong learning and professional development;* *• Able to plan, implement and audit information systems, provide contingency operations that include administrative planning process for incident response, disaster recovery, and business continuity planning within information security;* *• Able to critically analyse an organisation's current state, propose and justify business and information systems solutions for process innovation and digital transformation, develop management plans to facilitate digital transformation, and mitigate related issues;* *• Able to apply the PM processes to initiate, plan, execute, monitor and control, and close projects and to coordinate all the elements of the project, considering the scope, time, costs and quality, ensuring satisfying the needs for which project was undertaken.*
Final examination upon the completion of the study programme	*Master's Thesis*

Study programme forms

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*• Bachelor of Science degree in computer science, informatics, mathematics, or Bachelor of Engineering degree in electrical engineering, electronics, information and communication technologies with a mastered program of at least 120 CP. • Second-level professional higher education or bachelor's degree in economics, management science, logistics, finance, business and other fields, with at least 1 year of professional experience in the field of ICT, after discussions with the director of the study program and the entrance exam specialty.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*

Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*• Bachelor of Science degree in computer science, informatics, mathematics, or Bachelor of Engineering degree in electrical engineering, electronics, information and communication technologies with a mastered program of at least 120 CP. • Second-level professional higher education or bachelor's degree in economics, management science, logistics, finance, business and other fields, with at least 1 year of professional experience in the field of ICT, after discussions with the director of the study program and the entrance exam specialty. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*80*

Admission requirements (in English)	*Bachelor of Science degree in Computer Science, Informatics, Mathematics, or Bachelor of Engineering in Electrical Engineering, Electronics, Information and Communication Technologies; number of completed credit points – at least 120 CP Second-level professional higher education or Bachelor's degree in Economics, Management Science, Logistics, Finance, Business and other fields, with at least 1 year of professional experience in the field of ICT, an interview with the study program director and an entrance exam in Speciality*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years, 6 months - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*• Bachelor of Science degree in computer science, informatics, mathematics, or Bachelor of Engineering degree in electrical engineering, electronics, information and communication technologies with a mastered program of at least 120 CP. • Second-level professional higher education or bachelor's degree in economics, management science, logistics, finance, business and other fields, with at least 1 year of professional experience in the field of ICT, after discussions with the director of the study program and the entrance exam specialty. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address

Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies distance education - 2 years, 6 months - english

Study type and form	*Part time extramural studies distance education*
Duration in full years	*2*
Duration in month	*6*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*• Bachelor of Science degree in computer science, informatics, mathematics, or Bachelor of Engineering degree in electrical engineering, electronics, information and communication technologies with a mastered program of at least 120 CP. • Second-level professional higher education or bachelor's degree in economics, management science, logistics, finance, business and other fields, with at least 1 year of professional experience in the field of ICT, after discussions with the director of the study program and the entrance exam specialty. For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - latvian

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*Second-level professional higher education or a Bachelor's degree in Computer Science, Informatics, Mathematics or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, provided that the bachelor's degree has been obtained by studies of at least four years' duration and comprises 160 units*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*

Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 1 years, 6 months - english

Study type and form	*Full time studies*
Duration in full years	*1*
Duration in month	*6*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*Second-level professional higher education or a Bachelor's degree in Computer Science, Informatics, Mathematics or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, provided that the bachelor's degree has been obtained by studies of at least four years' duration and comprises 160 units For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*60*
Admission requirements (in English)	*Second-level professional higher education or a Bachelor's degree in Computer Science, Informatics, Mathematics or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, provided that the bachelor's degree has been obtained by studies of at least four years' duration and comprises 160 units*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 2 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*
Admission requirements (in English)	*Second-level professional higher education or a Bachelor's degree in Computer Science, Informatics, Mathematics or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, provided that the bachelor's degree has been obtained by studies of at least four years' duration and comprises 160 units For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies distance education - 2 years - english

Study type and form	*Part time extramural studies distance education*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*60*

Admission requirements (in English)	*Second-level professional higher education or a Bachelor's degree in Computer Science, Informatics, Mathematics or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, provided that the bachelor's degree has been obtained by studies of at least four years' duration and comprises 160 units For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) or a document certifying a bachelor's degree, master's degree or higher education obtained in Latvia, except for cases where the previous education was obtained in English.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Natural Sciences in Computer Application*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

No.	Parameter	Changes made in the period since the previous accreditation	Changes made in the process of accreditation
1.	Field of Study	---	---
2.	Name of the study programme		
3.	The code of the study programme in accordance with the Latvian Classification of Education		Changed from 45526 to 45 482, in accordance with the regulations of the Cabinet of Ministers No. 322 "Regulations on Latvian Education Classification".
4.	Type and level of the study programme	---	---
5.	Amount of the study programme (KP)		Programme implementation variant in the amount of 60 CP has been added

6.	Form, type, duration of programme implementation	Added part-time distance learning form. With June 3, 2015 Study Accreditation Commission decision No. 371, and January 23, 2019 decision No. 98-A decision	Programme option in the amount of 60 CP with the duration of implementation 1 year 6 months in full-time studies and 2 years in part-time studies
7.	Language of instruction		Latvian and English The programme was previously also accredited with Russian as a language of instruction, the last students studying in Russian will graduate from the programme in June 2023. *Article 49 of the Transitional Regulations of the Law on Higher Education, according to which it is prohibited to enrol students for studies in Russian after January 1, 2019.*

8.	Place of implementation		Place of implementation is Riga. The programme was previously accredited with an implementation site in Riga and the Latgale branch of the TSI in Daugavpils. *In spring 2022, the Latgale branch of TSI was closed and excluded from the Register of Higher Education Institutions*
9.	Director of the study programme		

10.	Admission requirements		Clarified by setting the admission requirements for applicants with education in the relevant field, if the bachelor's degree was obtained in at least four years of studies in the amount of 160 CP; or in three-year studies in the amount of 120 CP. There are certain admission requirements for students with "non-professional" education, but who have at least 1 year of professional experience in the field of ICT. In this case, discussions with the director of the study programme and an entrance exam for the specialty are planned

11.	Awarded degree		Changed from "Engineering master's degree in information systems management" to " Master of Natural Sciences in Computer Application ", in accordance with MK regulations no. 322 "Regulations on Latvian Education Classification "
12.	The goal of the study programme		Changed according to the title and content of the programme, taking into account the changes in the demand of the modern labor market and current events in the field of computer science.
13.	Tasks of the study programme		Changed according to the content of the programme, taking into account the changes in the demand of the modern labor market and current events in the industry.

14.	Learning outcomes		Learning outcomes have been refined in line with the goal of the programme, updated study course outcomes and European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) requirements for level 7, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.
15.	Final test		--

Changes to the degree to be awarded and to the education code

The Master's programme " Management of Information Systems" was licensed and accredited in 2012 with the degree to be awarded - Master of Engineering Science in Management of Information Systems, education classification code 526. Although at the time of licensing and accreditation of the programme the Cabinet Regulations were already in force, which stipulate that academic programmes shall be awarded a degree in the relevant group of branches of science related to the relevant sciences according to the subject groups of education defined in the Latvian Classification of Education, neither when licensing nor when accrediting the programme did the Commissions find a problem in the fact that the degree to be awarded in the programme was not written exactly with the same words as in the relevant group of educational programmes defined in the Cabinet Regulations " Regulations on the Classification of Education in Latvia".

The programme itself is interdisciplinary, looking at all business processes through the prism of ICT. According to Cabinet Regulation No 49 "Regulations on Latvian scientific branches and sub-sectors", ICT falls under the sub-sector of science - engineering and technology - electronics, electrical engineering and information and communication technologies.

Although the degree Master of Engineering in Information Systems Management more accurately describes the content of the programme itself and better corresponds to the purpose of the programme, in order to ensure compliance of the programme with the requirements of Latvian legislation, the degree is changed to Master of Science in Computer Applications, educational classification code 482, as the only possible educational classification that most closely describes the study programme.

Changes to the duration of the programme

The programme has been extended with short version (60 CP), taking into account that according to Article 57 of the Law on Higher Education Institutions, the total duration of full-time Bachelor's and Master's studies shall not be less than 5 years. TSI academic bachelor level programmes are 160 CP (4). The same programme size also applies to the programmes of the University of Latvia and several other higher education institutions, as well as to the programmes of second-level professional higher education. The short version of the programme of 60 CP will make the programme more competitive in the Latvian education services market and will also attract foreign students.

The program of 80 CP and 60 CP differs only by one semester, which is 20 CP and which is called ("pre-master"). This semester contains certain study courses, the purpose of which is to provide fundamental knowledge of topics and areas that would be necessary for students to learn the basic part of the study programme. The common block "pre-master" in all specializations is Information Systems and Technologies, Artificial Intelligence, Modern Database Technologies. Also within each specialization there is a specific study course, for example, the Cybersecurity operations specialization includes the study course Operating systems and computer networks, the study of which is necessary for students to successfully master the next courses in this specialization. The Digital Transformation and IT project management specializations include the Financial Management course, which is required for the main part of the programme. In addition to the "pre-master", 2 CP are allocated to a course of free choice, which is recommended by the director of the study programme for each student individually, depending on previous education and professional experience. The recommendation is made after discussions with each student. In order to ensure such an individual approach to students, it is planned to actively use the possibilities of Coursera.

Changes in the program structure

Changes in the structure of the program are related to the specializations offered. New specializations are included in the program, taking into account the feedback of the alumni and students of the program, recommendations for the development of the program from industry representatives, as well as the development trends of the IT direction in Latvian and in the world. Specializations provide students with the opportunity to gain in-depth knowledge and competence in a specific direction: IT project management, Digital transformation, CyberSecurity operations. Each specialization consists of several new study courses (see Figure 4). As example, since the program is academic, the study course "Research Methodology" in the amount of 6 CP is included in the structure of the program, which combines the 3 study courses dedicated to research previously includen in the program, maintaining the total amount of CP. Following the recommendations of the industry representatives and the recommendations of the experts of TSI's strategic partner UWE Bristol, the course "Critical thinking and innovations" is taught in all master's level programs (including this). TSI partners note that critical thinking is one of the most in-demand skills.

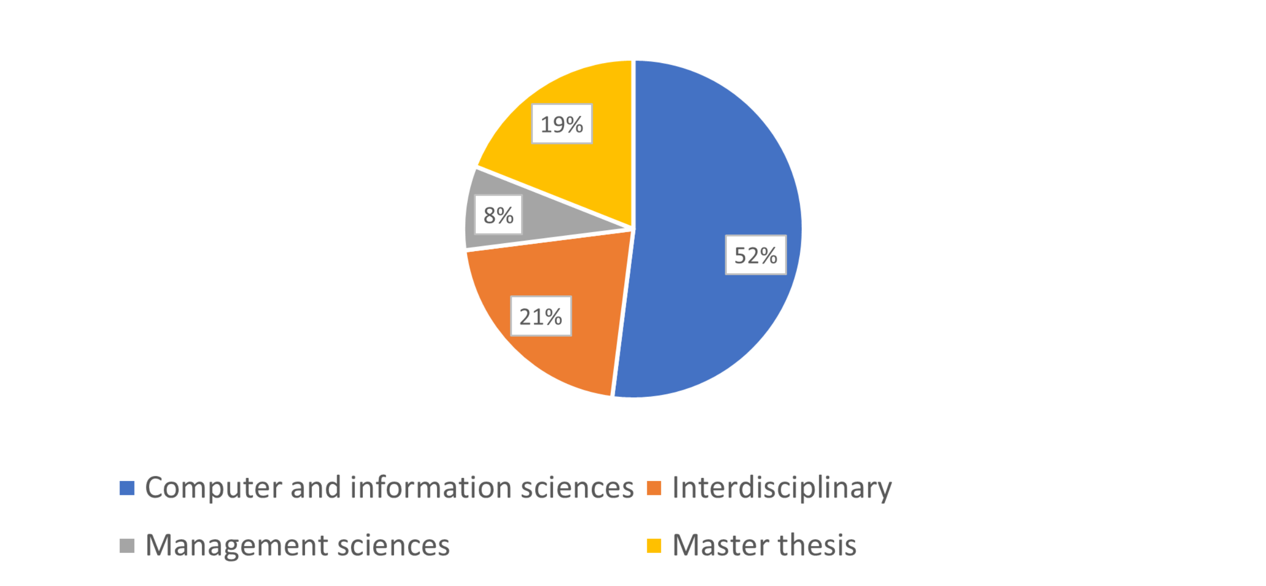
The mandatory content block of the program (block A) includes the study course Business Intelligence and data visualization, which replaces the study course related to BI technologies (in previous version of the programme). Such changes were determined by the development trends of the IT field, and also took into account Coursera's report on the most in-demand skills. This study course provides knowledge and skills in the field of data visualization, because data visualization and presentation are currently faced by managers of any level, and such skills are useful in scientific and research activities too.

Supplementing the program with new specializations and creating a short version of the program in the amount of 60 CP will make the program more competitive in the Latvian educational services market, as well as be attractive to foreign students.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

The name of the Master's study programme "Management of Information Systems" indicates that the programme belongs to the thematic field of education Computer science and thus logically fits into the study direction Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science.

The study courses included in the study programme serve as the basis for the study programme code and the awarded degree. The Master's study programme "Management of Information Systems" is interdisciplinary and covering both business and technological fields, provides students with knowledge of modern information and communication technologies and practical experience in the use of these technologies in various contexts. Each study course of the programme is a course of a branch of science, or the study course is marked as interdisciplinary. The programme includes study courses that refer to the following branches of science: computer science and informatics, management sciences, interdisciplinary course. The analysis shows that most of the courses relate to the field of computer science and informatics, 54 CP (81 ECTS), interdisciplinary study courses are 22 CP (33 ECTS), while the management science branch has courses with a total volume of 8 CP (12 ECTS). The analysis has been carried out taking into account all study courses of the programme, without dividing them by specialization. Graphically, the division of study courses by science branch is presented in Figure .



The division of study courses by science branch

Such a division of scientific branches indicates that the program belongs to the field of study "Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science". The master's programme "Management of Information Systems" fully corresponds to the programme group "Computer Application", code 482, included in the thematic field of education "Computers", which is part of the thematic group "Natural Sciences, Mathematics and Information Technologies". Therefore successful completion of the programme leads to a Master's degree in Natural Science, which is in accordance with the Cabinet of Ministers Regulation No 322 on the Classification of Latvian Education.

The aim and objectives of the Master's programme "Information Systems Management", as well as the study results obtained during the study, correspond to the seventh level of the Latvian Education Classification (Cabinet of Ministers Regulation No 322 "Regulations on the Latvian Education Classification").

The tasks defined in the study programme are aimed at achieving the programme objective "to provide students with knowledge and practical experience in the use of the latest ICT solutions to solve business problems in order to promote business competitiveness and development, as well as to develop innovative and critical thinking and research methods" and ensuring the study results.

The learning outcomes of the study programme are formulated using a student-centred approach, structuring and defining in detail the knowledge, skills, competences that the student possesses and is able to use and implement upon graduation.

The study programme is aimed at training qualified specialists in the field of information systems management who, depending on their specialisation, are able to strategically plan the use of the latest ICT solutions to solve business problems, systematically and comprehensively organise and manage all information technology resources of an enterprise, plan and manage ICT projects, develop and ensure enterprise cyber security plans, as well as conduct research activities in this field.

Employment opportunities are very wide - graduates work as heas of departments responsible for IT or IT project managers, business consultants in large and well-known information technology solution development companies or their representative offices in Latvia and other Baltic countries, as well as in manufacturing companies, state institutions, banks and medium-sized enterprises.

The mapping of study courses (Annex 6.3) for the achievement of the study programme learning outcomes allowed for in-depth analysis and specification of the learning outcomes of individual study courses. The aims, objectives and planned study results (knowledge, skills, competences) of the study programme "Information Systems Management" are interrelated and they are feasible.

The admission requirements are defined in the TSI Admission Rules and are based on the following regulations: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the Cabinet of Ministers Regulation No 846 of 10 October 2006 "On requirements, criteria and procedures for admission to study programmes".

According to Article 57 of the Law on Higher Education Institutions, the total duration of full-time Bachelor's and Master's studies shall not be less than 5 years. Master's programme admits students 1) with a Bachelor's degree in Computer Science, Informatics, Mathematics, or a Bachelor's degree in Electrical Engineering, Electronics, Information and Communication Technologies, where the Bachelor's degree was obtained in 3 years of studies (120 CP) - in this case the study duration is 2 years (80 CP); 2) or with a second level professional higher education or a Bachelor of Science degree in Computer Science, Informatics, Mathematics or a Bachelor of Engineering degree in Electrical Engineering, Electronics, Information and Communication Technologies, obtained in 4 years of studies (160 CP), in which case the study duration is 1.5 years (60 CP).

The admission rules also lay down requirements for applicants who have not obtained a relevant bachelor's degree in the field. This means that the admission rules allow graduates of programmes in other fields of study than ICT: economics, management, logistics, finance, business and other related fields, with at least 1 year of professional experience in ICT, to be enrolled in the study programme. In this case, the applicant will be required to have an interview with the programme director and to sit an entrance examination in the specialisation, see Annex 1 to the Admission Rules. This option reinforces and promotes the interdisciplinary format of the study process, ensuring a link with the students' practical activities and high motivation of such "non-professional" students.

The study program is implemented in Latvian and English full-time and part-time, but in part-time distance learning only in English. Although the study program is offered in both Latvian and English from the moment of licensing, the demand of applicants shows that it is very important to study the programme in English. The choice of such applicants is influenced by the fact that in the field of IT, English has de-facto become the basic language of communication, as most of the projects implemented by IT companies in Latvia are related to foreign countries (project clients or project partners). This means that IT specialists communicate in both languages (Latvian and English) on a daily basis, but knowledge of English in the IT field has become a mandatory requirement if a specialist wants to work and build a career in this field. Therefore, students believe that learning master's level study programmes in English provides them with both advantages and is a vital requirement to build a career both in Latvia and abroad. Often applicants who apply for studies in the form of distance learning studies are physically located outside of Latvia, where they are building their careers, and are therefore interested in obtaining education exactly in English.

Foreign applicants shall be matriculated after having passed a test of at least B2 level by an internationally recognised testing body or a TSI entrance examination in English of at least B2 level, except in cases where the previous education was obtained in English.

The applicants' preparation in their previous education, motivation to pursue higher education and the organisation of the study process at the TSI shall be such as to ensure the achievement of the programme's learning outcomes and the award of the Master of Engineering degree upon completion of the programme.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

The general situation of the labour markets is accurately described in the Ministry of Economics' annual information report "On medium- and long-term labour market projections", which states that "with the current structure of higher education supply, the most significant labour shortages in the higher education group are expected to be for specialists with a background in engineering, science and ICT (STEM) fields. The shortage of specialists with the relevant qualifications could exceed 9 000 by 2030 mainly in computer science, architecture and construction, physical sciences and engineering." (see Figure 1).

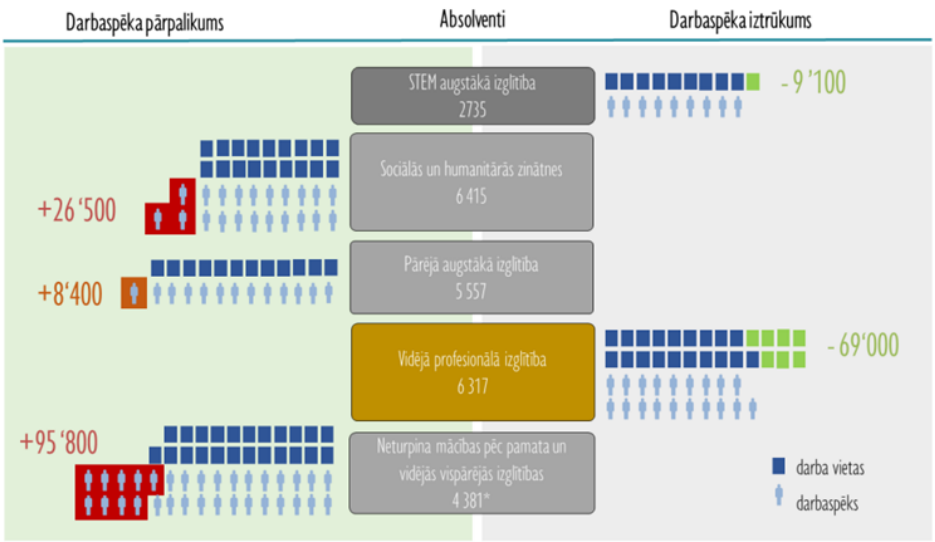


Figure 1. Projected labor surplus/shortage and number of graduates by education stages and fields, supply and demand gap in 2030, number of graduates in 2021

The report explains that "Despite the fact that fewer STEM-educated specialists are still being trained than the labour market will need in the coming years, the situation has improved markedly compared to the 2020 EM labour market projections, when more than 19,000 were forecast for 2030. A shortage of STEM-educated professionals is expected. It should be noted that the share of STEM graduates in the total number of graduates has increased from 13% to 19% between 2008 and 2021, which has also increased the overall supply of young professionals on the labour market."

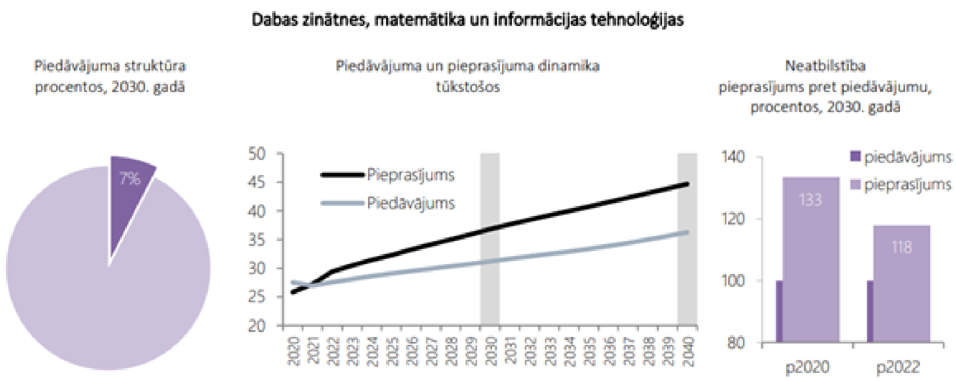


Figure 2. Piedāvājuma un pieprasījuma dinamika

According to the Ministry of Economy, the Master's programme of the TSI prepares specialists in a field where there is a significant labour shortage. As indicated in the report, the situation is improving year by year, but the labour shortage is still felt and has an impact on the economic development of Latvia in this field.

The COVID19 period demonstrated very well that the IT sector is one of the most stable. While other sectors experienced a downturn due to the restrictions imposed by COVID19, IT companies in Latvia weathered this period quite easily and, according to information received from industry, the workload of IT companies only increased. Given the development of concepts such as Industry 4.0, Bank 4.0, Healthcare 4.0, Marketting 4.0, etc., it is evident that digitisation is a key goal for the industry. As a consequence, the demand for specialists capable of implementing digitisation solutions is growing year by year. The platform prognozes.nva.gov.lv (at the National Employment Agency) shows that, for example, the demand for senior ICT professionals is growing rapidly (see Figure 3).

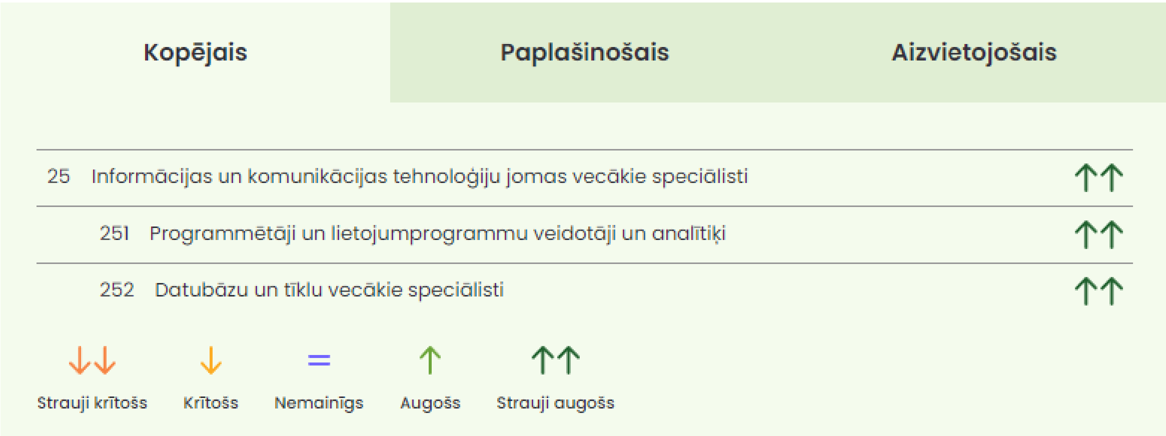


Figure 3. Demand for senior specialists

Given that this field is not only in demand for technical specialists, but also for interdisciplinary specialists who can effectively ensure communication between business and technical specialists, the number of potential students with no previous IT background is increasing. The experience of TSI's strategic partner UWE Bristol in delivering similar study programmes also shows that such "transformed" professionals are a valuable asset in demand on the labour market. The previous period of the programme demonstrated well that the programme provides the necessary knowledge and competences to advance a career in IT. For example, Katerina Alfimova, a graduate of the programme whose previous education was in logistics, successfully completed the study programme and is currently working in the IT company Idea Port Riga as an IT project manager and business analyst. The study programme is also valuable for IT professionals who have already established a career in the technical field and wish to continue their development in management positions. For example. Aleksandrs Avdeikins, Head of R&D at Trialto Latvia Ltd., points out that his technical knowledge and competences were sufficient, but the programme helped him to develop his management competences, as well as to structure his existing knowledge.

Taking into account everything described above it is possible to see how the trained specialists within the programme play an important role in the digitisation process in Latvia. As well as taking into account Latvia's RIS3 specialisation in ICT, the programme also provides an opportunity to "export" education in this field to other countries where digitisation solutions are only developing.

The majority of the 95% of students, taking into account also foreign students studying in this programme, are employed persons. Looking only at the Latvian students, 99% are employed and most of them are in companies dealing with IT or digitalisation issues. It should be noted that such specialists are in demand not only in the IT field, but also in other companies whose core business is not related to IT, e.g. the 2022 graduate Natalia Lazareva is successfully working at RIMI as a digitisation specialist. The Master's thesis was based on a topic proposed by RIMI and the company itself highly appreciated the business process digitisation framework developed in the Master's thesis

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The Master's study programme "Information Systems Management" is licensed and accredited in full-time and part-time studies in Latvian, Russian and English, and since 2014 also in part-time distance education.

The graphs in the annex show a steady increase in the number of students, especially in distance education.

A slight decrease in the number of students in the academic year 2019/2020 is due to the amendments of 21 June 2018 and 18 April 2021 to the Law on Higher Education Institutions of the Republic of Latvia, which stipulates that higher education institutions whose language of implementation of study programmes does not comply with the conditions of Article 56, paragraph 3 of this Law have the right to continue implementation of study programmes in the respective language until 31 December 2025. After 1 January 2019, the admission of students to study programmes with an implementation language that does not comply with the provisions of Article 56, paragraph 3 of this Law is not allowed. Thus, in the academic year 2019/2020, students were no longer admitted to study in Russian at TSI, which resulted in a decrease in the total number of students and the number of foreign students.

Foreign students were previously admitted to study in English and Russian, and many foreign students, mostly from former post-Soviet countries, took the opportunity to study in Russian. The academic year 2022/2023 is the last year in which the programme will continue to be conducted in Russian. Students have been informed of this, and if for any reason they do not graduate from the programme, they will be offered the opportunity to continue their studies in Latvian or English.

In recent years, there has also been an increase in interest among potential international students, especially in distance learning. Thus, in the last reporting year, 16 (18%) foreign students have enrolled in the programme.

The distribution of foreign students by country of residence in the academic year 2021/2022 is: Russian Federation -4, Uzbekistan, India, Pakistan - 3, and one from Germany, Estonia and Kazakhstan each.

The TSI studies are fee-only, but the Riga Technical University has a very wide range of programmes in the field of IT, where students have access to state-budget paid study places. Considering this fact it shall be stated that potential students demonstrate consistently strong interest in the TSI study programme and the relevance of the programme itself given the impact of the ICT sector on the economy.

The drop-out rate is around 15% annually, higher among foreign students. Statistics show that students drop out due to failure to complete their studies (the main reason for foreign students) or due to tuition fee arrears, or in some cases by choice.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

Not relvant

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study programme has been developed in accordance with the requirements of 13.05.2014. Cabinet of Ministers Regulation No.240 "Regulations on the State Standard of Academic Education" (can be seen in Annex 6.2.)

The study programme has been developed in compliance with the interrelation and sequence of study courses, which thus enables the maximum achievement of the aim of the study programme, to provide a set of knowledge, skills and competences in accordance with level 7 of the framework as defined in the Latvian Classification of Education.

In order to ensure the aim of the study programme, the set of knowledge, skills and competences to be acquired as a result of the study programme have been formulated (learning outcomes). In the light of the outcomes to be achieved within the study programme, specific study courses were identified and the scope of knowledge, skills and competences to be achieved within each individual course was defined (see the mapping of the study programme in Annex 6.3).

The correlation of the objectives and results of the study programme with the results of individual study courses can be found in each course description, which provides a description of the course content, the course plan, the requirements for the course, the results, the assessment methods and criteria, and the literature and other sources to be used.

The Master's programme of Information Systems Management provides both business and technological skills. It prepares internationally trained professionals with a deep knowledge of modern information and communication technologies and the use of these technologies in different contexts. The knowledge and skills acquired enable the graduate to become a valuable and important link between technology developers and users (society and business). The programme focuses on information systems management, change management aspects and the use of technology. During the study process, students are provided with lectures, practical assignments and case-studies under the guidance and supervision of the best local and foreign professors as well as professionals in the field.

The programme includes 3 specialisations. The specialisations were identified based on the results of alumni surveys and feedback from companies and associations. Figure 4 shows the structure of the programme and the specialisations. The 3 specialisations offered are Cybersecurity operations, Digital Transformation, IT project management. All 3 specialisations are offered in both the long version (80KP) and the short version (60KP). Each semester includes both common compulsory study courses and specialization specific study courses.

IT Project Management focuses on various aspects of IT project management, so in addition to the compulsory courses, this specialisation includes Financial Management, Project and Requirements Management, Information Systems Analysis and Design, Business Process Modelling and Analysis, as well as Software and Information Systems Quality Models. All the above specialisation courses provide the specific learning outcome: be able to apply project management processes to initiate, plan, execute, monitor and control and close projects and to coordinate all elements of a project, taking into account scope, time, cost and quality, ensuring that the needs for which the project was undertaken are met.

Digital Transformation focuses on the acquisition of different types of methods, approaches and frameworks to digitise different types of processes through ICT solutions, so in addition to the compulsory courses of the programme, the specialisation includes courses on Financial Management, Digital Transformation, Big Data, Enterprise Data Management, Business Process Modelling and Analysis. All of the above-mentioned specialisation study courses provide the specific study result: the ability to critically analyse the current state of the organisation, to propose and justify business and information system solutions for process innovation and digital transformation, to develop management plans to promote digital transformation and mitigate the associated problems.

The third specialisation, Cyber Security Operations, focuses on cyber security management issues and consists of the following courses: Operating Systems and Computer Networks, Cyber Security and Data Protection, Cyber Security Investigations, Information Risk Management, Big Data. All the above-mentioned specialisation courses provide the specific learning outcome.

The programme's compulsory courses of study provide the programme with both general knowledge of ICT, e.g. Information Systems and Technology, as well as specific knowledge on artificial intelligence, intelligent data analysis, advanced database technologies, data visualisation, etc. The programme is academic in structure and therefore includes two courses that develop research skills and critical thinking: Critical Thinking and Innovation, Research Methodology.

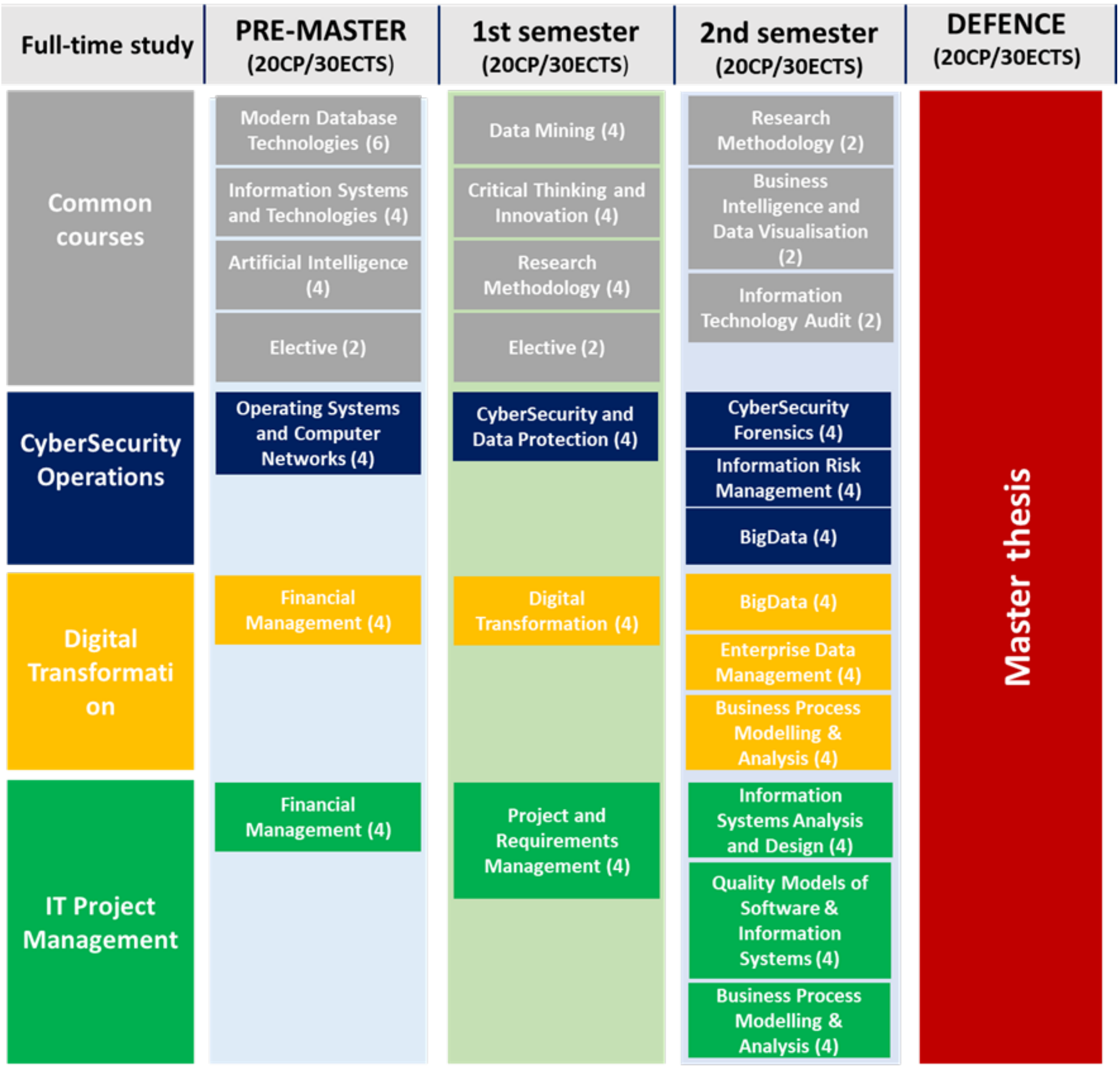


Figure 4. The structure of the study program and the relationship of the study courses with the study direction

The content of study courses is regularly updated in line with industry, labour market and scientific developments. According to the Gartner Group report, the study courses implemented in the programme are in line with new technologies/developments, see Figure 5.

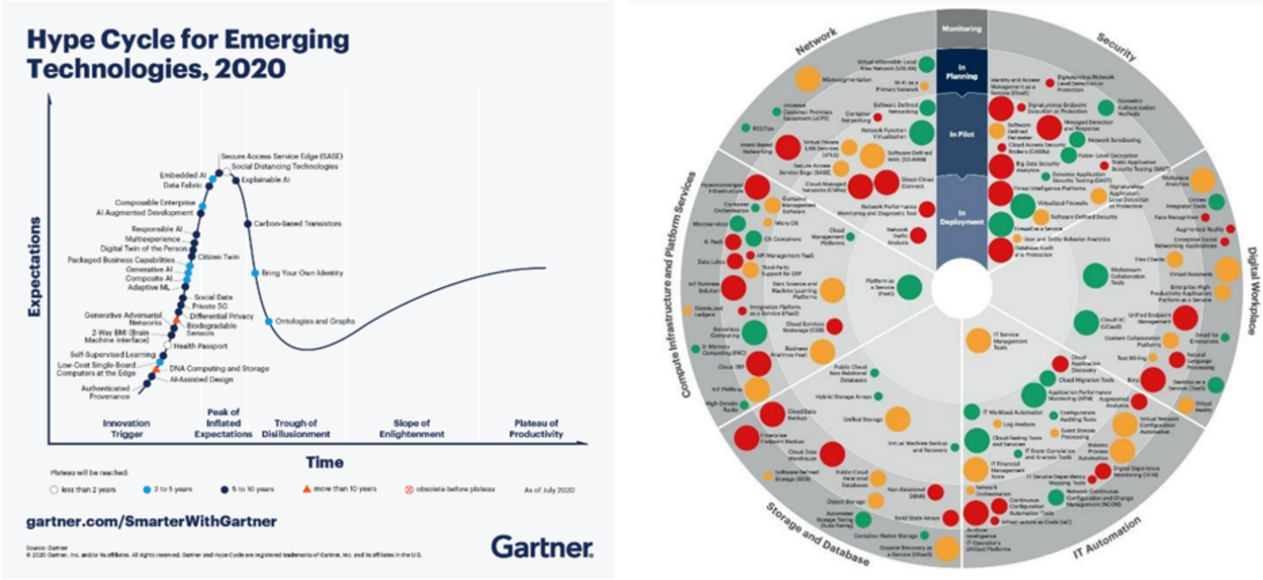


Figure 5. Emerging technologies according to Gartner Group

The continued relevance of the study programme is largely ensured by the vision of the programme lecturers - professionals and experts in the field - on the development trends in electronics, automation, robotics and ICT in their respective course of study. This is significantly facilitated by the active practical, scientific and research activities of the programme lecturers - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities, see Part 4 of the study field.

The program of 80 CP and 60 CP differs only by one semester, which is 20 CP and which is called ("pre-master"). This semester contains certain study courses, the purpose of which is to provide fundamental knowledge of topics and areas that would be necessary for students to learn the basic part of the study programme. The common block "pre-master" in all specializations is Information Systems and Technologies, Artificial Intelligence, Modern Database Technologies. Also within each specialization there is a specific study course, for example, the Cybersecurity operations specialization includes the study course Operating systems and computer networks, the study of which is necessary for students to successfully master the next courses in this specialization. The Digital Transformation and IT project management specializations include the Financial Management course, which is required for the main part of the programme. In addition to the "pre-master", 2 CP are allocated to a course of free choice, which is recommended by the director of the study programme for each student individually, depending on previous education and professional experience. The recommendation is made after discussions with each student. In order to ensure such an individual approach to students, it is planned to actively use the possibilities of Coursera.

The specializations of the programme: CyberSecurity Operations, Digital Transformation and IT Project Management, each of which is 20 CP, start already in the first semester and are learned in the form of modules. Specialization study courses by semester: 1st semester - 4 CP, second semester - 4 CP, third semester - 12 CP. Analyzing the content of the courses (see the mapping in the 80 CP and 60 CP variants in Appendix No. 6.3), it can be seen that both variants of the programme implementation allow to achieve the study results of the programme, and the set of study courses of each specialization allows to achieve the specific study results of the programme:

- Able to plan, implement and audit information systems, provide contingency operations that include administrative planning process for incident response, disaster recovery, and business continuity planning within information security
- Able to critically analyse an organisation's current state, propose and justify business and

information systems solutions for process innovation and digital transformation, develop management plans to facilitate digital transformation, and mitigate related issues.
- Able to apply the PM processes to initiate, plan, execute, monitor and control, and close projects and to coordinate all the elements of the project, considering the scope, time, costs and quality, ensuring satisfying the needs for which project was undertaken.

The study programme offers free-choice study courses (Part C), of which 6 credits are required to fulfil the programme requirements. The aim of these courses is to provide students with the opportunity to acquire additional knowledge in a field of science or to acquire skills useful for their professional activity. Each year the list of the elective courses is different, as TSI would like to follow the tendencies in IT industry, the example of elective courses Enterprise Information Systems, Unstructured data analysis, BlockChain etc. In addition to the courses offered in the programme, TSI students have the possibility to choose courses from another specialisation of their programme as Block C courses, or from Part B of the other study programmes implemented by the TSI, in coordination with their timetable in the Study Department. New study courses developed by the lecturers in the field of study of the programme are also offered in Block C. After such courses have been run, student feedback is collected on how interesting and useful the course has been, and if the feedback is positive, the course is included as a stand-alone course in Part B of the programme.

In accordance with Article 56 (point 7) of the Law on Higher Educational Institutions, foreign students learn "Latvian language for foreign students" in the amount of 2 CP. In the higher level programmes, foreign students learn the mandatory study course "Latvian language for foreign students" in the amount of 2 CP instead of free choice (block C) courses. For such students, within the programme, block C is reduced, in the programme "Management of Information Systems " it is 4 CP, but accordingly, the amount of the mandatory part of the programme increases by 2 CP.

In accordance with the requirements of the "Environmental Protection Law" and the " Civil Protection and Disaster Management Law ", if the previously acquired education has not covered the requirements set out in the Environmental Protection Law and the Civil Defense Law, students additionally learn the mandatory (Block A) study course " Labour Safety, Civil Defence and Environment Protection" in the amount of 2 CP (paragraph 4.8 of TSI Admission Rules)

The content and relevance of courses, including course descriptions, are reviewed annually during the annual self-evaluation of study programmes and fields of study in December-January, in accordance with the Course Management Regulations. As a result of the self-assessment, a programme development plan is drawn up, which includes the necessary updating of study courses, including course descriptions, in accordance with the trends in the field, the labour market and scientific developments. Feedback from students in course evaluation questionnaires and from graduates and employers is taken into account, providing input on the latest developments and current trends in the labour market. Updated courses of study are coordinated, approved and included in the Register of Study Programmes and uploaded to the e-learning environment Moodle before the start of the new academic year.

The assessment of the relationship between the objectives and the outcomes of the study programme and the objectives and outcomes of the study courses leads to the conclusion that the content of the study programme and the study courses allow the achievement of the overall objective of the programme "To provide students with knowledge and practical experience in the use of the latest ICT solutions to solve business problems in order to promote business competitiveness and development, as well as to develop innovative and critical thinking and research methods" and the learning outcomes.

3.2.2. In the case of master’s and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

The Master's programme closely follows developments in the sector. Ideas for improving the study process are provided by employers and professional organisations during seminars, conferences, round tables or personal contacts of lecturers, addressing a range of questions about students' competences, as well as issues related to students' employability in today's labour market. The content of the courses is therefore developed in a sequential manner, in line with developments in the field. The industry experts and guest lecturers involved in the study process also make an important contribution to the education of the Master students by providing feedback on the need to improve the study process and by pointing out relevant aspects of the business environment. This gives students the opportunity to gain practical skills that will be needed in the labour market.

Knowledgeable and competent lecturers who work in both industry and science, such as Jelena Kijonoka, who works at Accenture Baltics and teaches courses in Artificial Intelligence and Enterprise Data Management, guest lecturer Neil Ruben, who works at VISA Corporation and teaches a course in Big Data, as well as other lecturers who are actively involved in projects and active in research. Irina Jackiva, Dmitrij Pavlyuk and others.

The content of the study programme is designed in such a way that each course emphasises applied research. The aim of the study programme is to provide students with knowledge and practical experience of the latest information and Internet technologies for solving business problems in order to promote business competitiveness and development. At the same time, the content of several courses included in the programme is based on current standards. For example, the course "Project and Requirements Management" uses the PMP standard, the course "Software and Information Systems Quality Models" is based on the CMMI model and the ITIL standard. All study courses use modern software, which allows students to get an idea of modern technologies, for example, in the study course "Data Mining" students use SPSS or STATISTIKA software, in the optional study course "Enterprise Information Systems"- ERP and CRM information systems.

The scientific and research activity of the academic staff makes a significant contribution to the development of the study programme and improvement of the study content. Lecturers participate in local and international scientific conferences and seminars, publish research results in scientific publications, develop teaching aids. Through research, lecturers bring the most up-to-date innovations and scientific trends into their study courses by including new study courses or topics into the study programme, e.g. the study course Information Systems and Technologies aims to provide knowledge about ICT solutions, the study course Artificial Intelligence aims to provide knowledge about artificial intelligence solutions in the business environment, etc.

In general, the content of the Master's study programme "Information Systems Management" is updated according to the trends of the industry, labour market and scientific development, providing opportunities to acquire in-depth knowledge of information and communication technologies, as well as the use of these technologies in different contexts, thus ensuring the interdisciplinary approach that is so necessary nowadays.

The study programme for the Master of Science degree is based on the advances and insights of the information and communication technologies sector. The degree is awarded after the defence of Master's thesis, independently prepared and publicly defended under the supervision of an experienced researcher, which contains original research results and provides new insights into the relevant field of science. For each Master's thesis, students carry out quantitative or qualitative research, justifying the novelty of the research and contributing to the development of science.

In general, the study programme provides mastering of modern theoretical concepts in the field of Information and Communication Technologies, mastering of research methodology and methods, provides mastering of skills in training of leading management specialists in the field.

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The study programme is implemented in accordance with the study plan, which is available to students in the TSI information system. For learning study courses, according to the specifics of the study course, lectures, practical works, laboratory works and students’ independent work are planned. In master's level courses, 40 hours per credit point (1.5 ECTS) are provided, including contact hours and students' independent work. Out of 40 hours in master's level courses, 12 hours (per 1 credit point (1.5 ECTS) are intended for contact hours, the rest is independent work. In the form of distance learning, 1 contact hour is provided for 1 credit point (1.5 ECTS), which is used for introductory lectures and consultations. Proportion between lectures and practical lessons (including laboratory classes) is specific for each study course and is determined by the teaching lecturer, depending on the study results of the course and the methodological aspects of the course. The mentioned contact hours for full-time and part-time study forms do not include consultations for students. According to TSI regulatory documents, during the semester the lecturer 1 load, it is necessary to provide 32 hours of consultations for students (the amount of consultations decreases proportionally with the lecturer's workload). The consultations are scheduled and visible in the schedule of lectures. During the consultations, the lecturer both answers the students' questions and additionally explains the course material.

The learning-by-doing approach is predominantly used for the study courses included in the programme. This approach implies that students are not only provided with theoretical material during the course of the assignment, but are also immediately offered to try out the tasks, which they are expected to complete in order to gain practical experience. E.g. In the Big Data course, students develop and present their own solution based on big data technologies.

As a form of study organisation, lecturers use a flipped classroom approach, where students are provided with preparatory material, e.g. parts of books, case studies (as example from Harvard Business Review), but during the class itself they discuss the material or complete a specific assignment. E.g. in the free elective course "Enterprise Information Systems", one of the assignments should use the AHP (Analytic Hierarchy Process) method to justify the choice of information systems to be implemented in the company. Prior to this, students are provided with access to both a youtube recording explaining the approach of the AHP method and a scientific publication explaining the nuances of applying the AHP method specifically to the selection of an information system. Students are required to independently explore the application of the AHP method and already during the lesson students complete a specific project.

For each course of study, the TSI LMS (e.tsi.lv) has its own section where the lecturer publishes the course materials (e.g. presentations, assignments, etc.). Using the TSI LMS, students submit their work for assessments.

In practice, the process of assessing students' knowledge takes place regularly throughout their studies. The final assessment of students' knowledge is made at the end of the semester after the results of all stages: practical work, seminars, independent work, mid-term tests and examination. The lecturer of each course has developed an assessment methodology, which indicates the percentage of the total mark that each assessment criterion represents. At the same time, the lecturers use assignments which give the student the opportunity to test themselves and receive feedback. Such tests do not affect the final grade of the course, but provide the student with an opportunity for self-testing (formative assessmens). A large number of lecturers use an assessment method based on performance assessment rubrics or rating scales. This approach ensures that students understand at the outset how a particular piece of work will be assessed and also allows the lecturer to increase the effectiveness of the assessment, as the student receives not only a mark but also feedback on each criterion. This approach to knowledge assessment increases the efficiency of the stages, because in this case we can speak directly about the learning process and not only about the assessment of the submitted work.

The same approach to assessing learning outcomes is also used in distance learning.

The methods used in the study programme contribute to the achievement of the objectives and learning outcomes of the courses and the programme, ensure student-centred learning, encourage students to take an active part in shaping the learning process and ensure that students' performance is appropriately assessed. The principles of student-centred education, which are applied in the same way in all programmes of the University, are described in more detail in Part 2.3.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

Since the previous accreditation, more than 90 Master students have graduated from the Information Systems Management study programme. Many of the students are already employed in the ICT field during their studies or are planning to change their career to the ICT field, therefore the current field of employment and interests of the student are taken into account when formulating the topics of the Master's thesis.

In the last lesson of each course, the lecturer introduces the students to the problem situations relevant to the course of study, thus enabling the students to develop their Master's thesis research in this direction.

All Master's programmes include a compulsory (Block A) course "Research Methodology" of 6 CP, which focuses on an active discussion of the possible topic of the Master's thesis. During the course the student prepares a master's thesis application; prepares the first part of the master's thesis by analysing the current situation in the research area (state of the art); students are provided with information on the topics of the master's thesis, which are offered both by the faculty members of TSI and TSI cooperation partners - Accenture Baltics, Deloitte Latvia and others. For example, Accenture Baltics presents to students possible Bachelor and Master thesis topics in September-October, at the same time offering these topics to possible consultants from their company. The topics offered by the companies are chosen by relatively few students - about 5%. This is due to the fact that students often choose their Master's thesis topics in relation to their current workplace. Below is an example of how the final thesis topics offered by Accenture Baltics look like (see Figure 6).

Master thesis topics are often related to extending existing methodologies/approaches or proposing new methodologies/approaches. Examples of such master thesis titles: "Extension of methodology for CRM system implementation in a university"; "Development and study of a computer model of IT HRM information system competences"; "Evaluation and analysis of the effectiveness of integration of UI/UX design methodologies in different SDLC models"; "Development of a conceptual framework for business process automation"; "Improvement of decision-making system with ML-algorithms in a telecommunication company". The 6.8. appendix contains examples of the topics of the defended master theses.

This provides students with the opportunity to develop a Master's thesis in a topical scientific and practical field.

Figure 6. Example of master thesis proposal from Accenture

Participation in a scientific conference is a prerequisite for the defence of the Master's thesis, for the in-depth approbation of the Master's thesis topic. Students of all master's study programmes implemented by the TSI present the results of their research work at the students' scientific conference "Science and Technology - a Step into the Future" -RatSif, which is held twice a year at the University - in December and April. The aim of the conference is to promote students' professional development in parallel with the acquisition of theoretical material of study courses, acquiring scientific research skills in research methodology, selection of research methods, summarising theoretical findings of science, practical research execution, ability to conduct research data acquisition, analysis and interpretation, as well as to express the obtained research results in justified and understandable conclusions; to promote students' scientific creativity, thus strengthening the link between studies, practice and scientific research activity. This will assess the novelty of the research results and their relevance to the field of study. After the conference, students are given recommendations for further work.

For the Master's thesis prepared and uploaded to the TSI Thesis Portal, the supervisor prepares a review, which evaluates the thesis and provides comments on the development of the thesis itself. The supervisor evaluates the thesis according to the following criteria: relevance of the thesis content to the set aim and objectives; relevance of the conclusions to the set objectives; degree of use of literature and other sources of information; compliance with the thesis development schedule; presentation of the final thesis text according to the requirements; compliance with the supervisor's instructions.

Master's theses are reviewed. The reviewer is usually a senior lecturer of the Engineering Faculty who has practical or scientific experience in the subject area. The reviewer assesses the thesis against the following criteria: the aim and hypothesis/objectives of the thesis; the degree of use of literature and other sources of information; research methods; analysis of results; conclusions; organisation and style of the thesis; and the overall assessment of the thesis. To reduce the subjectivity of the evaluation and to ensure that students understand the evaluations given in the supervisor's feedback or review, performance evaluation scales with textual descriptions are used.

The defence of the final thesis shall be assessed by a Committee chaired by a representative of the employers with a PhD degree. The Master's thesis and the defence itself are evaluated individually by each member of the committee, with the committee voting on the final evaluation at the end of the defence. The committee evaluates the following criteria: the relevance of the thesis to the chosen topic (in terms of scope and content); the ability to apply the knowledge, skills and competences acquired during the studies to solve the tasks set in the thesis; the ability to present the thesis in accordance with the requirements; the ability to present the thesis results; the ability to discuss and answer the questions. The student has 3 days to appeal against the defence procedure. The final grade is communicated to the student individually. Figure 7 below shows the distribution of grades from 2012 to 2022. As can be seen in the graph 32% of the students received a grade 7 (good), 31% - 8 (very good). The average grade is 7.5. The average grade for females is 7.8, for males 7.2.

The positive evaluations reflect the high scientific quality of the Master's theses, the ability to defend the research results convincingly and argumentatively, as well as the graduates' preparedness and suitability for the labour market. The highest grade of "excellent" is awarded only for outstanding performance and if the student has presented at an international or national conference, produced a scientific publication, or presented the work at a competition (hacktons as example). According to the data collected and taking into account that there were no appeals within the programme from 2012 to 2022, we consider that the work has been assessed objectively and that the final grade fully reflects the level and quality of the work and its defence.

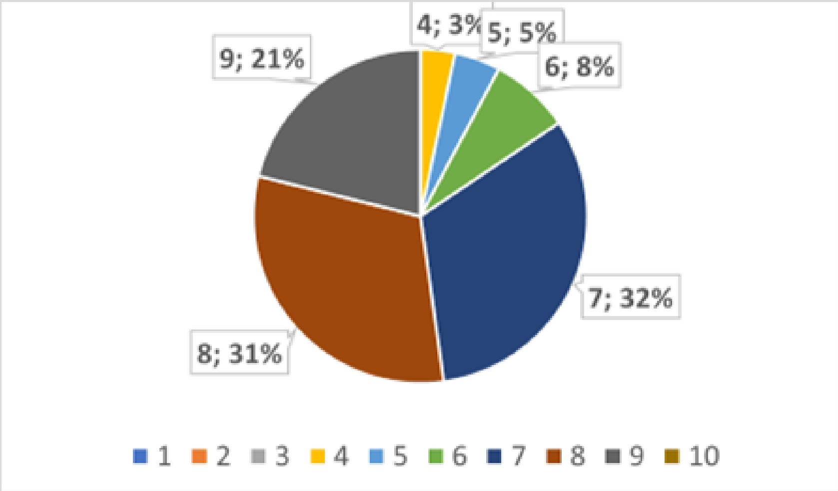


Figure 7. Distribution of grades for the defense of master's theses (2012-2022)

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

In the study direction report in sections 2.3.2. - 2.3.4 the full information on these issues is provided. This paragraph only provides additional and separate information on the study programme.

The study process is mainly provided by the staff of the Faculty of Engineering of the TSI. In addition, the humanities and social studies part of the course involves staff from the Faculty of Transport and Management Sciences.

The Faculty of Engineering of the TSI provides teaching and methodological work: creates and updates course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and defends bachelor theses and carries out other activities related to teaching, methodological and scientific work. The Digitisation and Innovation Learning Centre is responsible for the development and deployment of teaching methodological materials for distance learning courses on the TSI Learning Management System platforms.

The TSI library is available for use by students. The TSI library provides access to the Academic Complete database, which is available online for both students and faculty. The Academic Complete database is a database of scholarly e-books created by ProQuest, containing more than 180 000 titles in all major fields of science. The SCOPUS database, which focuses more on scholarly publications, is also available to students. The library staff organises regular sessions to inform students about the latest library news and how to use the library resources.

Software provided by TSI is used in the study process. The range of software is quite wide, e.g. Microsoft Dynamics AX, Microsoft Dynamics CRM, SPSS, STATISTIKA, Microsoft Project, Microsoft

VISIO, etc. JIRA, LucidChart, etc. Practical classes for full-time and part-time students take place in computer labs. Distance learning students have access via a remote server to which students can log in and use the software remotely.

A contract with Coursera was signed in 2022. The aim of the agreement is to develop cooperation and to provide both faculty and students with the opportunity to obtain specific courses from the Coursera catalogue. It is an opportunity for the teaching staff to both improve their qualifications and to use Coursera courses in their studies. This agreement also provides the opportunity to develop courses using Coursera tools. This aspect is very important for the development of the distance learning form of study.

The common study, scientific, informational (including library), material-technical and financial base of the TSI and the Faculty of Engineering creates the preconditions for the achievement of the study results and demonstrates the possibility of ensuring a quality study process in the study programme "Information Systems Management".

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the programme's inception, tuition fee income has been the main source of funding for the study process. The programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee per full-time student is EUR 2400 per year, per part-time student - EUR 1920 per year, distance learning - EUR 1700 per year. The amount of tuition fees for each academic year shall be determined and approved by an order of the Rector. The tuition fee payment procedure is laid down in the Regulation of the tuition fee payment procedure, which provides the possibility to pay tuition fees for the whole study programme, for one academic year, for one academic semester or as a monthly payment (starting from the 2nd semester).

Average costs is showed in Annex 6.7. There is no difference in the cost of studies in Latvian and English, as the studies are provided at a high quality level without a breakdown by language of study, and therefore no difference in tuition fees.

The cost structure of the study programme in the last academic year 2021/2022 includes salaries and taxes (including costs of scientific publications, etc.). (including fees for teaching staff in accordance with the TSI Teaching Staff Remuneration Regulations) 55%, study programme development and implementation costs 5%, teaching materials and other similar costs 9%, scientific infrastructure costs and other similar costs 14%, advertising and marketing costs 2% , infrastructure costs (including IT costs) 6%, depreciation and amortisation 7%, other administrative costs 2% .

Each year, TSI provides students with the opportunity to receive personalised discounts of 50%, 75% and 100% on full-time tuition fees, which are awarded on a competitive basis.

To be cost-effective, the programme must have at least 6 students. It is taken into account that the programmes of the field of study respect the continuity of study courses, as well as the study plans of each programme are mutually coordinated - the courses included in the plan and their sequence by semesters. For example, all Master's level programmes teach the courses "Research Methods" and "Critical Thinking and Innovation" in order to develop research skills and critical thinking.

6 students is indicated as an average number, since as it has already been mentioned, several courses are taught jointly for different programmes. The costs for the full-time in-person study programme in the amout of the 80 CP are higher, therefore, more students are required for this programme - 7 people, part-time face-to-face - 5 people. The language of study does not affect the amount of costs.

This saves money and makes the programmes cost-effective with fewer students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The teaching of the study programme is provided by 14 teaching staff with relevant academic experience and qualifications, 10 of whom are elected lecturers.

7 professors and 1 associate professor, 7 of them with doctoral degrees in engineering are involved in the implementation of the compulsory and restricted elective part of the academic Master's programme "Information Systems Management": Dr.sc.ing.I.Jackiva, Dr.sc.ing., D.Pavlyuk, Dr.hab.sc.ing I.Kabashkin, Dr.sc.ing. I. Mishnev, Dr.sc.ing. I.Pticina, Dr.sc.ing. M.Savrasovs, Dr.oec.I.Kuzmina-Merlino as well as Associate Professor Dr.sc.ing. N.Spiridovska. Therefore, it can be concluded that the qualifications of the teaching staff involved in the implementation of the study programme fully comply with the Law of the Republic of Lithuania "Law on Higher Education Institutions", Section 55 (1), which stipulates that not less than five professors and associate professors who have been elected to academic positions at the respective higher education institution participate in the implementation of the compulsory and restricted elective part of the academic study programme.

In addition to the above-mentioned professors, 1 assistant professor and 2 lecturers are involved in the implementation of the programme.

A total of 80% of the academic staff involved in the programme holds a PhD in engineering. The lecturer Mg.oec.O.Skorobogatova is currently continuing her studies in the PhD programme "Digital Economy and Entrepreneurship".

The study process involves not only the academic staff of the study direction, but also a number of specialists in the field, including foreign lecturers, who with their professional experience not only deepen the students' practical knowledge and skills within the study course, but also increase the students' employability after graduation from the programme.

Currently, only 2 of the elected faculty members work in the companies of the industry: J.Revzina, cyber security engineer at iPro Ltd. and Cisco Networking Academy instructor, J.Kijonoka, data scientist at Accenture Latvia. Another guest lecturer representing industry companies is A.Berežnoj, who teaches the course "Information Technology Audit". The course "Big Data" is taught by guest lecturer Neil Rubens, who works at VISA Corporation.

Some study courses have several lecturers, or the main course is taught by the programme director, but it is already foreseen that for some topics industry representatives will be invited as guest lecturers, thus ensuring both the quality and topicality of the course content.

To enhance the quality of the programme, lecturers teach courses in one of the two languages only. Lecturers carry out scientific research and participate in the education of students. The Institute of Transport and Telecommunication ensures the professional development of its staff as far as possible and provides incentives with remuneration competitive in Latvia.

Foreign teaching staff: Neil Rubens (Big Data) teaches in English only in study programmes for both students studying the programme in English and students studying the programme in Latvian, taking into account that the university is entitled to no more than one-fifth of the credit points of the study program in a foreign language (Article 56, paragraph three of the Law on Higher Education Institutions, TSI study contract, paragraph 5.1.2).

The knowledge of the state language of the teaching staff involved in the programme complies with the Cabinet of Ministers' Regulation No 733 of 07.07.2008 "Regulations on the scope of knowledge of the state language and the procedure for testing the knowledge of the state language for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union and the state fee for testing the knowledge of the state language". The TSI Human Resources Department verifies national language skills at the time of recruitment.

In order to verify the English language proficiency of the teaching staff, periodic English language proficiency tests and, if necessary, additional training are organised at the TSI, e.g. in the academic year 2019/2020, several of the teaching staff did improve their English language proficiency in the courses organised in the framework of the project 8.2.2, and repeated English language courses are planned in the future from the funding of the University itself.

The qualifications of the teaching staff involved in the implementation of the study programme meet the conditions for the implementation of the study programme and the requirements of the regulatory enactments, ensure the achievement of the objectives and study outcomes of the study programme and the corresponding study courses

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff

over the reporting period and their impact on the study quality.

In the period since the previous accreditation in the academic year 2012/2013, changes have occurred in the composition of the teaching staff involved in the Master's programme "Information Systems Management".

Position	2012 /2013 academic year			2021 /2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professors	6		6	7		7
Associate Professors	1		1	1		1
Assistant Professor	2		2	2		2
Lecturers		1	1		1	1
Guest lecturers	1	1	2	2	1	3
Total			12			14

The total number of lecturers is almost unchanged, but only 3 professors continue to teach in the programme from the last accreditation: prof.I.Jackiva, prof.I.Kabashkin and prof.B.Mishnev.

During the reporting period, 6 new (elected TSI) lecturers have been attracted to the programme, teaching a specific course or a part of it. Of them, only lecturer O.Skorobogatova does not have a PhD degree, but she is currently studying in the PhD programme "Digital Economy and Entrepreneurship" at TSI. Several lecturers have advanced their academic experience and have been elected to higher positions. For example, M. Savrasov, the Director of the programme "Information System Management", in the previous reporting period lectured in the programme with Professor I. Jackiva, then obtained a PhD degree in 2013, in 2020 obtained the right of LSC expert, and from 2021 has been elected to the position of professor.

Several factors have influenced the changes in the composition of the lecturers. One of them is the generational change, as many lecturers were in the pre-retirement age group at the time of the previous accreditation. The programme now has a large number of younger lecturers (under 45). In addition to the already mentioned Prof. M. Savrasov, several of the TSI lecturers have obtained PhD degrees and are lecturing in the Master's programme: Prof. I. Pticina, Prof. J. Kijonoka, Prof. D. Pavlyuk, Associate Prof. N. Spiridovska.

The choice of lecturers is determined by the content of the study programme, which is continuously improved in accordance with the rapid development of the ICT industry. The programme includes study courses that ensure future competences, by attracting faculty members specialising in the particular field, including from the professional environment, to teach these courses. For example, the study courses related to artificial intelligence are taught by J. Kijonoka, a data scientist at

Accenture Latvia, in the Bachelor's and Master's level computer science programmes; the Big Data study course is taught by guest professor Neil Rubens, who is a leading data scientist at VISA Corporation; J. Revzina, who teaches the Data Protection and Cyber Security course, works as a leading cyber security specialist at iPro (Latvia). This allows the programme to be linked to practical activities, as information is obtained directly from professionals in the field themselves, and generates more interest among students.

During the reporting period, the University made targeted efforts to recruit teaching staff in order to best ensure the quality of study programmes. A human resources development plan for the faculty was developed, which provides for the improvement of the quality of study programmes by promoting the development of the existing academic staff, attracting academically recognised teaching staff, experts and professionals in the field, foreign guest lecturers, as well as students and graduates of the doctoral programme of the University.

Overall, it can be concluded that the changes in the structure of the teaching staff involved in the study programme are positive, that the relevant qualifications and experience of the teaching staff in academic work ensure a high quality of education and that it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for cooperation between teaching staff. Among other things, such cooperation ensures and promotes the development and interconnection of study courses. The development of study courses is carried out on a regular basis, based on suggestions made by students, trends in the field, the latest results of research, scientific activity and innovation. Taking into account the fact that studies are conducted in two languages and there are three forms of delivery (face-to-face, part-time and distance learning) and that there are situations when several teaching staff are involved in teaching one study course, the synchronisation of the study course content, assignments and evaluation system is a major problem. This problem has been solved centrally at the TSI by introducing a lead lecturer who is not only responsible for the course description but also ensures a unified approach to teaching the course (assessment system, assignments, etc.). The lead lecturer discusses the content of the course with other lecturers, agrees on a common methodological approach to assignments and their assessment, etc.

The leading lecturer discusses the content of the course with other lecturers, agrees on a common methodological approach to assignments and on their assessment, etc. The leading lecturer of the study course “Research Methodology” is Professor I. Jackiva. The course is divided into two parts, the first one is dedicated to the development of general research skills, and the second one – to an in-depth study of different research approaches and methodologies in order to prepare the students for the development of the final thesis in the relevant field of study. The course is taught in all Master level programmes and, accordingly, the directors of all Masters programmes were involved in its development. The first two topics of the course, which deal with the basic stages of the research and the use of a systems approach, interdisciplinarity in research, the main directions of the research in Europe and Latvia, etc., are taught by TSI Professor Igors Kabašhkins. In the last class of the first part of the course, which is also attended by the programme directors, the students discuss and publicly debate the objectives of their proposed research. The second part of the course is taught by the director of the corresponding programme.

In order to ensure the effective implementation of the study programme, the Director of the study programme engages the senior lecturers in an open discussion on the content of the study programme, study outcomes, and implementation approaches. Academic freedom is respected; any interested faculty member may participate in the discussions. This principle is followed in situations where a course of study belongs to another faculty, but the programme director has suggestions concerning the course of study. The discussions take place in an informal setting and aim at discussing and agreeing on the above aspects of the implementation of the study programme, as well as discussing the content of specific courses in order to avoid duplication of topics in the course content, and discussing the teaching methods used in the course.

Following the discussion, the programme director shall make proposals to be included in the annual self-evaluation of the programme. If a new course of study is proposed to be included in the programme, the discussion takes place during a formal meeting of the faculty: the need for the new course is discussed, the learning outcomes of the course are defined, and the lead teaching staff member responsible for the preparation of the course description and methodological material is identified. An expert is identified who will review the material and make recommendations to the lead lecturer.

The study programme Management of Information Systems is not intended to be implemented in a double diploma format with UWE Bristol (the concluded agreement does not provide for cooperation on the said program), therefore cooperation within the study programme between TSI and UWE Bristol teaching staff is also not planned. But taking into account the best practices of cooperation, the study programme Information Systems Management includes several study courses, which are taught together with the programme "Computer Science", e.g. Critical Thinking and Innovation, Business Intelligence and Data Visualization (Business Intelligence and Data Visualisation). The mentioned courses are provided by TSI teaching staff, but students can use UWE Bristol study materials (presentations, assignments, etc.) to learn the course. Within these courses, collaboration between TSI and UWE faculty is planned to discuss assignments and study approaches.

In the course of study, the Board of the Study Programme invites the TSI's business partners (e.g. Deloitte Latvia, Accenture Baltics and others), professional organisations and associations (Information and Communication Technology Association (LIKTA), Latvian Electrical Engineering and Electronics Industry Association (LETERA)) and representatives of the student self-government in order to obtain their opinion on the planned changes to the study programme or the inclusion of new courses in the programme.

The total number of teaching staff involved in the implementation of the programme is 13, while the total number of students on 1 October 2022 was 50 in full-time/part-time studies and -30 in distance education, thus the student-teacher ratio is 4 and -2 in distance education.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annex 6.6. Diplom MIS.zip	6.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	Annex 6.9 Opinion of the Council of Higher Education.docx	6.9.pielikums. AIP atzinums TSI_Mg ISV_250.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 6.1.Statistics on the students.pdf	6.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 6.2. Compliance with the State Education Standard.docx	6.2.pielikums. Atbilstiba akademiskajam standartam 3001.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 6.3. Mapping of the study courses.xlsx	6.3.pielikums. Studiju kursu kartejums.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 6.4. The curriculum of the study programme.zip	6.4.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 6.5. Descriptions of the study courses modules.zip	6.5.Studiju kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)		
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	Annex 6.10. Confirmation.pdf	6.10.pielikums. Apliecinajums atbilstiba AL.pdf

Robotics (43523)

Study field	*Information Technology, Computer Hardware, Electronics, Telecommunications, Computer Management, and Computer Science*
ProcedureStudyProgram.Name	*Robotics*
Education classification code	*43523*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Aleksandrs*
Surname of the study programme director	*Kraiņukovs*
E-mail of the study programme director	*Krainukovs.A@tsi.lv*
Title of the study programme director	*Dr.sc.ing.*
Phone of the study programme director	*28316834*
Goal of the study programme	*The aim of the programme is to provide the undergraduate education in Electronics and Automated Systems, which forms the graduates' theoretical knowledge, practical skills and competences necessary for successful professional activity and knowledge development in the fields of industrial Robotics and autonomous robots*

Tasks of the study programme	*• to provide a comprehensive education in the technical field study courses that are considered to be core courses in Robotics: Electronics and Electrical Engineering, Mechanics, Programming and Automatic Control; • to ensure the learning of mathematics and physics sections, which are necessary for solving the practical tasks in Electronics, Mechanics, Programming and Automatic Control relevant to Robotics; • to develop the students' algorithmic thinking and to build the practical programming skills needed to develop the Robotics applications; • to provide the basic knowledge about the robot constructions and to develop skills in modelling and design of robot structural elements; • learning the principles of design and operation of electronic devices and embedded systems of robotic applications and developing practical skills in modelling and design of electronic devices, including embedded systems; • to develop the students' knowledge of automatic control systems for Robotics and the skills in the use of optimal control methods and artificial intelligence algorithms; • to develop the skills in the use of computer technologies aimed at correct and efficient solving the practical tasks of Robotics and designing the constructive modules of robotic equipment; • to develop students' knowledge of the design and operation principles of industrial and autonomous robots; • to provide the experience in practical work in Robotics through the laboratory work in Electronics, Mechanics, Embedded and Robotic Programming, Automatic Control and Design Systems according to the plan of each semester; • to develop the students' skills in solving the practical industrial tasks in Robotics independently; • to develop the students' understanding of the principles of autonomous robot design and the ability to design autonomous robots independently; • to develop the students' understanding and knowledge in the field of the principles of work organisation, social issues and economic activity.*

Results of the study programme	*• to know the principles of industrial and autonomous robots functioning and peculiarities of their use; • to be able to apply the theoretical knowledge acquired in the field of Electronics, Automatic Control, Programming and Mechanics to solve the practical problems in the field of Robotics; • to be able to develop the control applications for the execution of the technological operations of industrial robots, preparing them for the execution of the technological operations, taking into account the safety requirements of the robotic production processes; • to know and apply the principles of integration of electronic devices, drive systems, mechanical components and information devices in the design of the autonomous robots; • to be able to model and design the robotic devices and their structural elements using computer technologies and software; • to be able to work effectively both independently and in teams with minimal supervision to perform design and manufacturing tasks in the field of Robotics; • to be able to continuously improve their professional skills by analysing the evolution of the Robotics development and its main technical and scientific fields; • to be able to organise and manage the communication in a professional environment, respecting the principles of professional and general ethics.*
Final examination upon the completion of the study programme	*Bachelor's Thesis*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*

Language	*english*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) , except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Physics and Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - latvian

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*160*
Admission requirements (in English)	*Secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

Part time extramural studies - 5 years - english

Study type and form	*Part time extramural studies*
Duration in full years	*5*
Duration in month	*0*
Language	*english*
Amount (CP)	*160*

Admission requirements (in English)	*Secondary education For studies in English, it is necessary to present a CE certificate in English, or an assessment in English in the documents of previous education, or English language examination of an internationally recognized testing institution at least at B2 level, or the result of the TSI English language entrance examination (only for those completed education in Latvia) , except for cases where the previous education was obtained in English. Foreign applicants have to pass an entrance examination in Physics and Mathematics*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Electronics and Automation*
Qualification to be obtained (in english)	--

Places of implementation

Place name	City	Address
Transport and Telecommunication Institute	RĪGA	LOMONOSOVA IELA 1, LATGALES PRIEKŠPILSĒTA, RĪGA, LV-1019

3.1. Indicators Describing the Study Programme

3.1.1. Description and analysis of changes in the parameters of the study programme made since the issuance of the previous accreditation form of the study field or issuance of the study programme license, if the study programme is not included on the accreditation form of the study field, including changes planned within the evaluation procedure of the study field evaluation procedure.

N	Parameter	Changes made in the process of accreditation
1.	Field of Study	The programme is licensed on 21.11.2018, licence No. 04038-24, but it is not included in the accreditation sheet of the field of the study
2.	Name of the study programme	----

3.	The code of the study programme in accordance with the Latvian Classification of Education	When changing the type of programme from professional to academic, according to the Latvian Classification of Education, the first and second digits of the code change from 42 to 43, but the group corresponding to the subject area of education is retained, that is - 523. The Cabinet of Ministers Regulation No. 322
4.	Type and level of the study programme	Converted from the professional Bachelor programme of the second level to an academic Bachelor programme.
5.	Amount of the study programme (CP)	The amount of the programme has been changed from 180 CP to 160 CP.

6.	Form, type, duration of programme implementation	The programme with the volume of 180 CP was implemented in 4 years and 6 months of full time studies and in 5 years and 6 months of part time studies, changing the programme volume to 160 CP, with the duration of implementation of 4 years for full time studies, and 5 years for part time studies
7.	Language of instruction	---
8.	Place of implementation	----
9.	Director of the study programme	----
10.	Admission requirements	----
11.	Awarded degree	Professional Bachelor of Science in Electronics and Automation changed to Bachelor of Engineering in Electronics and Automation.

12.	The goal of the study programme	The previously awarded qualification of Electronics Engineer is not awarded in the programme.
13.	Tasks of the study programme	Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.
14.	Learning outcomes	Modified according to the changed title and content of the programme, taking into account the changes in the demand of contemporary labour market and current trends in the field of computer science.

15.	Final test	Learning outcomes have been refined in line with the goal of the programme, updated study course outcomes and European Qualifications Framework (EQF) and Latvian Qualifications Framework (LQG) requirements for level 6, and the total number of learning outcomes has been reduced in accordance with AICA recommendations. Therefore, the competences, knowledge and skills acquired in the individual courses contribute to the achievement of the defined learning outcomes in a logical sequence.
16.		----

The study programme "Robotics" was licensed as a second-level professional programme in 2018. After discussions with employers and industry experts, it was decided to transform the programme into an academic programme and award a Bachelor of Engineering degree in electronics and automation at the end of the programme in accordance with the Cabinet of Ministers' Regulation "Regulations on the Classification of Latvian Education". The conversion of the programme "Robotics" into an academic programme has reduced the programme size from 180 CP to 160 CP, with a corresponding change in the duration from 4 years 6 months full-time to 4 years part-time. The structure of the programme has also been changed accordingly:

1. The study course "Production Practice" (12 CP) has been removed from the programme, while the study course "Teaching Practice" has been reduced from 8 CP to 6 CP.

2. The final thesis "Bachelor thesis with project part" has been deleted and the project part has been reduced from 12 CP to 10 CP.
3. "Digital Image Processing and Computer Vision" (4 CP) has been removed from the study plan of the Bachelor programme, but an improved course of the same title has been included in the study plan of the Master study programme "Computer Engineering and Electronics", which corresponds to the complexity and level of study of the course.
4. "Optimisation Methods" (2 CP) has been excluded from the study programme, as the material of this course is included in the Master's study programme "Computer Engineering and Electronics".
5. The total number of credits in the English language courses is reduced from 8 CP to 6 CP.
6. The study course "Materials Engineering" has been increased from 2 to 4 CPs, as this study course belongs to the core courses in robotics.
7. As the programme has been re-designated as an academic programme, the course "Introduction to Scientific Research" has been included in the curriculum at 2 CP.

Changes to the programme's curriculum:

1. increase the competitiveness of the study programme by reducing the duration of studies by one semester, maintaining all general education study courses and two specialisation study courses.
2. maintains the opportunity to develop students' practical and professional competences in industrial robotics and autonomous robots through internships, practicals and laboratory sessions in the TTI teaching laboratories, as evidenced by the existing demand for an academic Bachelor degree in Robotics among senior students who have not yet completed an internship.
3. maintain the interdisciplinary link of the programme.
4. develops the competences necessary for research in robotics.

3.1.2. Analysis and assessment of the study programme compliance with the study field. Analysis of the interrelation between the code of the study programme, the degree, professional qualification/professional qualification requirements or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements. Description of the duration and scope of the implementation of the study programme (including different options of the study programme implementation) and evaluation of its usefulness.

According to the regulation of the Cabinet of Ministers No. 49 of 23.01.2018 “Regulations on Scientific Industries and Sub-Industries of Latvia", Robotics is included in the Engineering and Technology industry group and in the scientific area of Electrical Engineering, Electronics, Information and Communication Technology. Robotics is a field that combines many of the leading technologies in Mechanics, Electronics, Information Technology and Automatic Control. Mechanical design is the basis of any robot. However, modern robots are advanced automatic devices with embedded electronics and software that define the functionality and autonomy of robots and allow the use of the Information Technology to solve the robotic tasks. Artificial intelligence techniques are used to perform complex tasks and robots in complex environments.

The name of the Bachelor study programme “Robotics” indicates that the programme belongs to the field of Information and Communication Technologies and thus logically fits into the study field "Information Technologies, Computer Engineering, Electronics, Telecommunications, Computer Management and Computer Science”.

The structure of the study programme “Robotics” comprises four science subfields: “Electrical Engineering, Electronics, Information and Communication Technologies”, “Computer Science and Informatics”, “Mechanical Engineering and Mechanics”, and “Material Science”. Almost Almost 80% of the program volume covers the first two of the sub-sectors mentioned here, the study courses of these two groups provide the preparation of the student base of the program and provide students with knowledge and develop competences in electronics, automation and information technologies and computer technology, which are necessary for industrial robotics and autonomous robot operation management for solving practical tasks. The study courses of the third group form students’ knowledge and competences on the robot structures and dynamics, which must be taken into account in the design and the use of robot control systems and the software implementation of robot operation control algorithms in both industrial and autonomous robots.

The aim and the tasks of the Bachelor programme “Robotics”, as well as the learning outcomes obtained during the study, correspond to the sixth framework level of the Latvian education classification (Cabinet of Ministers Regulation No. 322 “Regulations on the Classification of Latvian Education”).

The tasks defined in the study programme are aimed at achieving the programme goal “to provide the undergraduate education in Electronics and Automated Systems, which forms the graduates’ theoretical knowledge, practical skills and competences necessary for successful professional activity and knowledge development in the fields of industrial Robotics and autonomous robots” and ensuring the study results.

The achievable learning outcomes of the study programme are formulated using a student-centred approach, structuring and defining in detail the knowledge, skills and competences that the student possesses and which the student is able to use and implement after graduation.

Upon the completion of the Robotics programme, the graduate will be able to use the theoretical knowledge acquired in the field of Electronics, Automatic Control, Programming and Mechanics to solve the practical problems in the field of Robotics, will be able to work effectively both independently and in teams with the minimal supervision to perform design and production tasks in the field of Robotics, and to improve continuously his or her professional skills by analysing the peculiarities of the development of Robotics and its main technical and scientific fields.

Successful completion of the programme leads to obtaining the Bachelor of Engineering degree in Electronics and Automation, which complies with Regulation No. 322 of the Cabinet of Ministers “Regulations on the Classification of Latvian Education”, and also indicates the content of the programme and its affiliation to the thematic area of Engineering and Technology and the Electronics and Automation group of educational programmes.

The admission requirements are determined in the TTI Admission Regulations and are based on the following normative acts: Articles 46 and 47 of the Law on Higher Education Institutions, as well as the Cabinet of Ministers Regulation No. 846 of October 10, 2006 “On Requirements, Criteria and Procedures for Admission to Study Programmes”. A student who has passed the secondary school leaving certificate, who demonstrates proficiency in the national language and in a foreign language and in Mathematics (e.g. by successfully passing the centralised examinations) is eligible to study in a higher education programme.

The study programme is implemented in Latvian and English. For studies in English, applicants are matriculated on the basis of the results of the CE certificate in English, a test score of at least B2 level from an internationally recognised testing institution or the TTI entrance examination in English (only for those who have completed secondary education in Latvia).

Foreign applicants are matriculated on the basis of the results of an internationally recognised testing institution test in English at least at level B2 or a TTI entrance examination in English at least at level B2, except in cases where the previous education was obtained in English, and an entrance examination in Mathematics and Physics

The amount of study programme implementation is 160 CP, the duration of the implementation in full-time studies is 4 years, in part-time studies - 5 years. The study courses included in the programme in the amount of 160 CP allow the achievement of the study outcomes of the programme (see the Map in Appendix 1.3) and the aim of the programme. Such a scope and duration of the programme is optimal for learning the study programme for the following reasons:

- the amount of study courses for each specialisation of the programme is 20 credit points, which corresponds to one full-time study semester or more than one part-time study semester;
- the significant number of limited elective professional courses in the amount of 48 CP, common to both specialisations, related to the four basic areas of "Robotics": Electronics, Information Technologies, Automatic Control and Mechanics;
- 4 CP learning practice.

Such volume of 72 CP of professional training courses allows the graduate of the programme to acquire in-depth knowledge and to develop the practical skills in Robotics and become a competitive specialist in the fields that correspond to the specialisations of the Robotics study programme .

Such preparation of the applicants in their previous education, motivation to obtain higher education and organisation of the study process, TTI is able to ensure the achievement of the study results of the programme, and after graduation of the programme to award the Bachelor of Engineering degree in Automatics and Electronics.

3.1.3. Economic and/ or social substantiation of the study programme, analysis of graduates' employment.

Robotics has entered our lives rapidly in recent decades and this trend continues to grow. Robots are widely used in areas such as industrial production, energy, transport, healthcare, security and defence, aerospace and military industries, aviation services, agriculture and even the entertainment industry.

Industrial robots are currently the most widely used of all types of robots. According to the International Federation of Robotics (IFR), since 2016, the operational stock of industrial robots had been increasing by 14% on average each year. In 2021, the operational stock of industrial robots was computed at 3,477,127 units (+15%) (Executive Summary World Robotics 2022 Industrial Robots. Available on the Internet: https://ifr.org/img/worldrobotics/Executive_Summary_WR_Industrial_Robots_2022.pdf). Robot installations in Europe were up 24% to 84,302 units in 2021. This represents a new peak. Demand from the automotive industry was steady, while demand from the general industry was up by 51%. Germany, which belongs to the five major robot markets in the world, had a share of 28% of total installations in Europe. Italy followed with 17% and France with 7%. The IFR forecasts that the growth rate of industrial robot density in Europe will be at least 10% in the coming years (IFR presents World Robotics Report 2022 #WorldRobotics. Available on the Internet: https://ifr.org/ifr-press-releases/news/wr-report-all-time-high-with-half-a-million-robots-installed).

Representatives of leading companies in the field describe the pace of robotization in Latvian manufacturing:

- More than ten new industrial robots installed in industrial companies every year from 2018-2020;
- In 2022, more than 30 types of industrial robots of different complexity have already been installed to perform various technological operations;
- By 2024, the number of industrial robots used by Latvian companies will reach 400.

Industrial robots are the backbone of automation in manufacturing technology, but service robots are also becoming increasingly important in people's lives. The development of service robots is an important instrument of the fourth industrial revolution or INDUSTRY 4.0. In 2024, IFR forecasts the following trends in the service robot market (medical systems, mobile robots, service robots for personal and household use, etc.) (IFR presents World Robotics Report 2022 #WorldRobotics. Available on the Internet: https://ifr.org/ifr-press-releases/news/wr-report-all-time-high-with-half-a-million-robots-installed):

- expanding the set of practical tasks and operations carried out by service robots;
- an estimated one million service robots for sales and professional use in the manufacturing and non-manufacturing sectors;
- 42 million service (consumer) robots for personal and household use.

The increase in robot density is not reducing the number of workers in the robotics and automation sector, but the opposite. According to the German Mechanical Engineering Association (VerbandDeutscherMaschinenundAnlagenbau - VDMA), the number of employees in robotics and automation is increasing in Germany. However, this growing demand is for skilled professionals who can design, build, implement and maintain robotic systems and machines (Presentation of World Robotics 2022. Available on the Internet: https://ifr.org/downloads/press2018/2022_WR_extended_version.pdf).

Industrial robotics is currently in high demand for industrial robotics developers, industrial robot programmers and maintainers, and operators of multifunctional robotic complexes. This trend will continue in the future. The IFR forecasts that by 2027, there will be a significant increase in demand for occupations related to service robots, such as home robot developer, social robot developer, medical robot developer, neuro-interface developer for robot control, child robotics developer.

The Bachelor's programme "Robotics" corresponds to the information and communication technologies specialisation niche of Latvia's Smart Specialisation Strategy, as the programme considers modern robots as automated devices with embedded electronics and software that determine the functionality and autonomy of robots and enable the use of information technologies in solving robotics problems.

The Latvian Ministry of Economy's information report on medium- and long-term labour market forecasts states that "By 2040, labour demand will continue to shift in favour of specialists with higher education". There will also be a more pronounced shortage of professionals with vocational training. By 2027, the gap between labour supply and demand for professionals with a vocational education could increase to 37 000 professionals. The supply and demand for education in Natural

Sciences, Mathematics and Information Technology in 2027 is estimated at 112% (Darbaspēka pieprasījuma un piedāvājuma sabalansētība - EM) - Supply - 31083, Demand - 34919, Shortfall - 3836

The projected surplus/shortage and number of graduates in STEM (supply-demand gap in 2027, number of graduates in 2019) is 2850 graduates and -14000 labour shortage (CSO data for 2019. EM projections for 2027).

The educational services market offers bachelor programmes in the field of Mechatronics, Adaptronics and Computer Management: academic bachelor programmes “Intellectual robotic systems” (RTU), professional bachelor programmes “Mechatronics” (RTU), “Adaptronics” (RTU) and “Mechatronics” (RTA). The competences of the graduates of these programs are determined by the profile of the study programme, which is not sufficient to solve the wide range of practical robotics tasks. In contrast to these study programmes, the structure of the bachelor study programme “Robotics” is dominated by study courses in Electronics, Information Technology and Automatic Control. Mechanics study courses provide students with knowledge of the kinematics and dynamics of autonomous and industrial robots, as well as the principles of robot construction and autonomous robot design. The creation of the programme structures and specialisations was supported by large industrial companies and professional organisations dealing with production robotization and automation, development of industrial and autonomous robots, as well as robotic devices.

Currently, there is no such bachelor's degree programme in Robotics in the other two Baltic States, although bachelor's degree programmes specialising in robotics are offered in the education services market. The bachelor's programme "Mechatronics and Robotics" at Vilnius Technical University in Gediminas (Lithuania) offers the knowledge and develops the practical skills necessary for an industrial engineering specialist to design, manufacture and operate mechatronic and robotic systems, but with a predominance of mechatronics courses. Kaunas University of Applied Engineering (Lithuania) runs a professional bachelor's degree programme "Electronic Engineering" specialising in "Automated Systems and Robotics", with two courses on industrial robots. Both programmes are taught in both Lithuanian and English. The bachelor programme "Product Development and Robotics" at Tallinn University of Technology (Estonia) allows specialisation in robotics, considering industrial robots as a technological tool for production, taught only in Estonian.

The TTI undergraduate education programme "Robotics" differs significantly from these programmes in its balanced distribution of courses in the core branches of robotics, as well as two specialisations relevant to the development of modern robotics. TTI offers studies in the national language as well as in English, the main international language of industrial and engineering communication.

There are currently no graduates, as the first graduation will take place in early 2024. However, most of the students are involved in robotics projects and have already signed cooperation agreements after defending their final thesis.

Given the relevance of the structure and specialisation of the academic Bachelor's degree programme "Robotics" to robotics trends and the demand for qualified robotics professionals, the programme is supported by major industrial companies and professional organisations involved in robotics and automation, industrial and autonomous robots, as well as robotics equipment development.

The structure and specialisation of the programme, as well as the provision of professional and practical competences, enable students to be competitive on the labour market both in Latvia and in European Union countries.

Overall, the following conclusions can be drawn:

- the academic bachelor's study programme "Robotics" is in line with both the Latvian Smart Specialisation Strategy (RIS3) and the needs of the national economy;
- the analysis of the development plans of the Republic of Latvia, the needs of the economy and society in the field of INDUSTRY 4.0 clearly indicate the need to continue the training of specialists in the Robotics programme;
- the professional and practical competences of the graduates of the Robotics programme will enable them to be competitive in the labour market both in Latvia and in the European Union countries.
- in the coming years, this TTI programme can make a significant contribution to the development and modernisation of industry in Latvia and the whole Baltic Sea Region.

[1]Executive Summary World Robotics 2022 Industrial Robots. Available on the Internet: https://ifr.org/img/worldrobotics/Executive_Summary_WR_Industrial_Robots_2022.pdf

[2]IFR presents World Robotics Report 2022 #WorldRobotics. Available on the Internet: https://ifr.org/ifr-press-releases/news/wr-report-all-time-high-with-half-a-million-robots-installed

[3]Presentation of World Robotics 2022. Available on the Internet: https://ifr.org/downloads/press2018/2022_
WR_extended_version.pdf

[4]Germany Trade and Invest. The Robotics & Automation Industry in Germany FACT SHEET ISSUE 2022. Available online: https://www.gtai.de/resource/blob/2516/9e87feac66357ba6e19fc33e648f4ca4/20211118_
FactSheet_RoboticsAutomationIndustryGermany.pdf

3.1.4. Statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down into different study forms, types, and languages.

The Bachelor's study programme "Robotics" was licensed full-time full-time and part-time part-time in Latvian and English in 2018, with the first intake of students in 2019/2020.

The graphs in the annex show a steady upward trend in the number of students. While in the academic year 2021/2022 fewer students were enrolled than in the two previous years, in September 2022 10 students matriculated, 6 full-time, 4 part-time.

There is one foreign student (from Kazakhstan), enrolled in the academic year 2021/2022.

As a private educational institution, TTI is fee-only. Similar programmes in robotic systems are also run by Riga Technical University, where students can apply for state-budget study places. This demonstrates the stable interest in the TTI study programme and the relevance of the programme itself, given the impact of the ICT sector on the national economy.

The Robotics programme is implemented in 4-year studies, so there are no graduates. In the academic year 2021/2022, one student was withdrawn because he was unable to combine his studies with work. But he had to work because of the difficult financial situation of his family.

In order to promote students' interest in robotics as a technical field, a Lego robotics club and a robotics and electronics club have been running at the TTI since 2014, except during the COVID-19 quarantine months. Each year, approximately 20 students attend the club in two age groups: a younger group from 8 to 11 years and an older group from 12 to 15 years. Each group meets twice a week for 2 academic hours. The classes are led by I. Lacs, a lecturer at the Faculty of Engineering at TTI. The "Lego Robotics" group regularly participates in the Latvian Robotics Championship (TTI organises one of the LRC events every year before Christmas), tournaments in Vilnius and Tallinn, regularly winning prizes. Every year, students aged 15 and up take part in the "Robotics and Electronics" club, where they build free-form robots to take part in various robotics tournaments. "The Robotics and Electronics Club takes place once a week (4 academic hours) and is led by teachers from the Faculty of Engineering and engineers from the Telecommunications, Electronics and Robotics Centre (TERC). These clubs have a positive impact, as 25% of the students enrolled in the robotics programme were members of the clubs during their school years and won prizes in robotics tournaments.

In addition to robotics classes, TTI teachers teach open robotics classes in schools in Riga. In the academic year 2022/23, the 12th grade of Riga Purvciems Secondary School is taking a 140-hour course "Fundamentals of Robotics" in the TTI TERC laboratories.

3.1.5. Substantiation of the development of the joint study programme and description and evaluation of the choice of partner universities, including information on the development and implementation of the joint study programme (if applicable).

3.2. The Content of Studies and Implementation Thereof

3.2.1. Analysis of the content of the study programme. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators with the aims of the study course/ module and the aims and intended outcomes of the study programme. Assessment of the relevance of the content of the study courses/ modules and compliance with the needs of the relevant industry, labour market and with the trends in science on how and whether the content of the study courses/ modules is updated in line with the development trends of the relevant industry, labour market, and science.

The study programme has been developed in accordance with the requirements of 13.05.2014. The compliance with the requirements of the Cabinet of Ministers Regulation No.240 "Regulations on the State Standard of Academic Education" can be seen in Annex 1.2.

The study programme has been developed in compliance with the interrelation and sequence of study courses, which thus enables the maximum achievement of the aim of the study programme, to provide a set of knowledge, skills and competences in accordance with the knowledge, skills and competences of level 6 of the framework as defined in the Latvian Classification of Education.

In order to ensure the aim of the study programme, eight elements of the set of knowledge, skills and competences to be acquired as a result of the study programme have been formulated. In the light of the outcomes to be achieved within the study programme, specific study courses were identified and the scope of knowledge, skills and competences to be achieved within each individual course was defined (see the mapping of the study programme in Annex 1.3).

The correlation of the objectives and results of the study programme with the results of individual study courses can be found in each course description, which provides a description of the course content, the course plan, the course learning requirements, the results, the course evaluation methods and criteria, and the literature and other sources to be used.

The structure of the study programme "Robotics" includes professional study courses for the four scientific and technical basic areas of robotics: mechanics, electronics, information technology and automatic control. The programme has two specialisations: "Industrial Robotics" and "Autonomous Robots", each of which contains compulsory general education and industry theoretical courses and training courses in information technology of 72 CP (Part A), compulsory industry vocational training courses and vocational specialisation elective courses of 68 CP (Part B) and free elective courses (Block C) of 6 CP.

The compulsory theoretical and information technology courses (Part A) and the compulsory sector-specific vocational training courses (Part B) total 118 CP. These courses correspond to the four fields of study with the following percentage of credits between them:

1. 52% - courses in the science sector "Electrical Engineering, Electronics, Information and Communication Technologies";
2. 26% - courses in the field of science "Computer Science and Informatics";
3. 18% - courses in the field of science "Mechanical Engineering and Mechanics";
4. 4% - courses in the field of "Materials Science".

Almost 80% of the CPs consist of study courses from the two groups of science "Electrical Engineering, Electronics, Information and Communication Technologies" and "Computer Science and Informatics". These study courses:

- preparing the student base for the Robotics degree programme;
- provides students with the knowledge and develops competences in electronics, automation and information technologies and computer engineering necessary to solve practical tasks in industrial robotics and autonomous robot control.

The third group of courses builds students' knowledge and competences on robot structures and dynamics, which need to be taken into account when designing and using robot control systems and robot control algorithms in both industrial and autonomous robots.

The specialisation courses are included in the limited elective part of the programme as specialisation B1- " Industrial Robotics " in the amount of 20 CP, and specialisation B2- " Autonomous Robots " in the amount of 20 CP. Students choose one of these specialisations during their studies. The specialisation courses start in semester 6 of the programme. The volume of all specialization courses is 4 CP, and the credit points are distributed by semester as follows: 4 CP – 6th semester and 8 CP - in the 7th and 8th semesters. Within each specialisation, there is continuity between the study courses, and the connection between the specialisations of the limited choice, general professional courses and the courses of each specialization.

- The specialisation courses in the 6th and the 7th semesters serve as the basis for the 7th and 8th semester specialisation courses, respectively;
- the courses of each specialisation are based on the limited elective specialisations for

common professional courses planned in the previous semester in relation to the specialization courses.

The study programme offers free-choice study courses (Part C), of which 6 credits are required to fulfil the programme requirements. The aim of the secourses is to provide students with the opportunity to acquire additional knowledge in a field of science or to acquire skills useful for thei rprofessional activity. Several elective courses are offered every year, for example, Philosophy, Digital Marketing. In addition to the courses offered in the programme, TTI students have the possibility to choose courses form another specialisation of their programmeas Block C courses, or from Part A or Part B of the other study programmes implemented by the TTI faculty, in coordination with their time tabele in the Study Department. New study courses developed by the lecturers in the field of study of the programme a real offered in Block C. After such courses have been run, student feedback is collected on how interesting and useful the course has been, and if the feedback is positive, the course is included as a stand-alone coursein Part B of the programme.

The study programme also includes the content requirements of the study courses set out in the Environmental Protection Law and the Civil Protection Law (Occupational Safety, Civil and Environmental Protection - 2 CP).

The basis for quality assurance of the study programme is cooperation with potential employers by organising meetings and discussing issues related to the current labour market trends, labour market demand, listening to suggestions at the Study Programme Board, reviewing annual self-assessment reports of the programmes. The relevance of the course of study is also ensured by the proportion of teaching staff recruited from industry.

The content of study courses is regularly updated in line with industry, labour market and scientific developments. The continuous relevance of the study programme is largely ensured by the vision of the programme lecturers - professionals and experts in the field - on the development trends in electronics, automation, robotics and ICT in the field of their respective study course topics. This is significantly facilitated by the active practical, scientific and research activities of the programme lecturers - participation in conferences, preparation of publications, presentation of reports, participation in research, scientific and experience exchange projects and activities.

The content of study courses, including course descriptions, and their relevance is reviewed annually during the annual self-evaluation of study programmes and fields of study in the months of December-January, in accordance with the Regulations for the Management of Study Courses. As a result of the self-assessment, a programme development plan is drawn up, which includes the necessary updating of study courses, including course descriptions, in accordance with the trends in the field, the labour market and scientific developments. Feedback from students in course evaluation questionnaires and from graduates and employers is taken into account, providing input on the latest developments and current trends in the labour market. Updated courses of study are coordinated, approved and included in the Register of Study Programmes and uploaded to the e-learning environment Moodle by the beginning of the new academic year.

The assessment of the relationship between the aims and outcomes of the study programme and the aims and outcomes of the study courses shows that the content of the study programme and the study courses allows the overall aims and outcomes of the study programme to be achieved. The content of the study courses included in the programme is up-to-date and relevant to the needs of the sector, the labour market and scientific trends. By successfully completing the programme, students achieve the expected results of the programme and acquire knowledge, skills and competences that are in high demand in the labour market. The content of the programme courses ensures continuity with higher level programmes.

3.2.2. In the case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation. In the case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels (if applicable).

3.2.3. Assessment of the study programme including the study course/ module implementation methods by indicating what the methods are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. In the case of a joint study programme, or in case the study programme is implemented in a foreign language or in the form of distance learning, describe in detail the methods used to deliver such a study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The methods of study implementation, assessment methods, types and requirements are included in the description of each study course, which is available to students in the e-learning environment Moodle.

The study process is mainly carried out in the form of interactive lectures, seminars, practical classes and students' independent work. The courses include practical activities, often including discussions, role-plays, teamwork, project work, specific professional performances or practical problem solving. The choice of method depends on the learning outcome the teacher intends to achieve. The methods used are aimed at developing the student's abilities to: learn, use knowledge creatively, cooperate, evaluate oneself, propose alternative solutions to problems, think critically, make responsible decisions.

The program is offered full-time on campus and part-time online (Saturday classes), and in both Latvian and English. Appendix 1.4 contains the curriculum for full-time and part-time study. The only difference in the curriculum for international students would be the substitution of the study course "Foreign language" with "Latvian language for international students" in Part A.

The basic principles and procedures for the evaluation of the study programme completion comply with the requirements of Article 40 of the National Standard for Academic Education. According to the provisions of the TTI Study Procedures, the study results in the academic bachelor study programme are evaluated according to two evaluation criteria: the qualitative criterion - a grade in the 10-point system and the quantitative criterion - credits based on the total number of hours in the study course. The complex method shall be applied for the assessment of the results of the study courses. It includes the assessment of students' practical work, individual or group work, intermediate examinations and final examinations (tests or examinations). In order to encourage students' continuous work, the final examination mark is set at a maximum of 50% of the final grade of the course. At the beginning of the semester, students are informed how the final result (grade) will be determined.

In practice, the assessment process takes place regularly throughout the study period. The final assessment of students' knowledge is made at the end of the semester after the results of all stages: practical work, seminars, independent work, mid-term tests and examinations. The lecturer of each course has developed an assessment methodology, which indicates the percentage of the total mark that each assessment criterion represents.

The aim of the laboratory classes is to deepen and consolidate the theoretical knowledge acquired, to teach students the methods of experimental and scientific research, to develop skills of scientific analysis and generalisation of the results obtained, to develop working skills with laboratory equipment, apparatus, control measurement devices, industrial and autonomous robots, means of debugging control programs. After the completion of the laboratory work, students submit a report and defend it.

Work with autonomous and industrial robots, electronic equipment, embedded robot control systems, computer and modelling software is an integral part of the study process, with a special focus on teaching placements in the TTI laboratories "Industrial Robots" and "Mobile Robots" at TERC, which provide invaluable practical work experience.

Independent study plays an important role. A description of how this is done is included in the course description as a compulsory component. Students' ability to study independently is purposefully developed in all study courses. Students acquire research skills by regularly working with literature and internet resources in order to successfully produce various coursework and a bachelor thesis. This encourages students' scientific research work, working with international scientific databases available in the TTI library.

During the study process, according to the study program, the student must develop coursework in part A of the study course: "Robot programming" and "Robotic device control" and a group project.

The coursework is necessary for the successful acquisition of knowledge and skills. The coursework gives students the opportunity to work independently with the scientific literature offered and to apply the knowledge acquired in lectures in practice. During both course works, the student develops an algorithm for the operation of the robot according to the individual task, performs the software implementation of the developed algorithm, and tests the implemented control program using the mobile robot Khepera IV.

In the group project, special attention is paid to the students' group work: in the first lesson, the lecturer gives a task and the project groups of 2-3 students are formed in analogy with robot companies. Students learn to work in teams, which is particularly important in the complex field of robotics. This requires students to study the literature intensively and to develop practical work, active and analytical participation in discussions. The group design culminates in the joint preparation of a final report, a presentation and a defence of the achieved overall and individual design results.

At the end of the Bachelor studies, the student chooses a topic of interest and, in collaboration with a supervisor of his/her choice, develops and defends a Bachelor thesis.

The study methods used in the study programme contribute to the achievement of the course and programme objectives and learning outcomes, ensure student-centred education, encourage students to take an active part in the design of the study process and ensure appropriate assessment of students' performance.

The principles of student - centred education and an individual approach to students are provided in the study programme:

- Learning outcomes. The evaluations of the study courses of the programme and the number of credit points are related to the learning outcomes. Students are informed about the results of each study course. The lecturers relate the results of the course to the results of the study programme, and also argue the necessity of studying the specific courses in order to become a computer science specialist in software engineering or artificial intelligence;

- Students are involved in the improvement of the content of the study programmes and study process through the students' surveys, as well as through involvement in the collegiate bodies of TSI and the Student Self-Government. Therefore, the students are provided with the opportunity to influence their own study process. Student representation in collegiate bodies is discussed in criterion 1.2 of the study field, the results of the student survey are shown in Appendix 7.
- Access to education and personalization of studies. When students study in the programme, a flexible study process is provided - various forms of study (on-site full time, part time, distance learning), the opportunity to create an individual study plan, which gives students the opportunity to combine work with studies already from the second year. Also, students of the day department have the opportunity to change the form of studying to part-time studies or distance learning in order to combine studies and work. Access to education is ensured by a digitized study process (e-library), discounts, social support (for foreign students, students who come to the university as part of mobility).
- Development of academic staff competencies. Pedagogical methods, study course structure and evaluation methods are chosen by the teaching staff responsible for the study course, according to the specification of the course content and programme, as well as the needs of the students. Courses and seminars on the latest teaching and pedagogical methods are organised for academic staff, as well as the attendance of qualification improvement courses is encouraged, both at internal faculty events, at the level of TSI, and internationally. More details are in the description of criterion 2.3.6 of the study field.
- Students receive feedback, which usually provides advice on the learning process and on ways to improve their learning and research skills.
- In the organization of research work (in the selection of topics of study projects and final theses), the field of interest of the students, the specificity of the practical work and experience are respected.
- Assessment is consistent, applied equally to all students and is carried out in accordance with the approved procedures, and learning outcomes are assessed in accordance with the Regulations on the Charter of Studies. The assessment criteria for each course of study must be communicated to the students by the teaching staff in the first lecture, and they are published in the TSI e-study environment. The description of each course specifies the connection of the study course evaluation criteria and methods with the learning outcomes of the study course, as well as specified conditions for taking exams. (See Appendix 1.5, descriptions of the study courses of the Bachelor study programme "Robotic")
- Procedures for examining the student appeals are in place and have been communicated to the students.
- Admission procedures and criteria are open. Admission rules with a detailed description of each programme are published on the TSI website in Latvian and in English.
- An information system has been created to ensure that the students can progress in their studies. More details are available in the description of criterion 2.3.4 of the study field.

3.2.4. If the study programme envisages an internship, describe the internship opportunities offered to students, provision and work organization, including whether the higher education institution/ college helps students to find an internship place. If the study programme is implemented in a foreign language, provide information on how internship opportunities are provided in a foreign language, including for foreign

students. To provide analysis and evaluation of the connection of the tasks set for students during the internship included in the study programme with the learning outcomes of the study programme (if applicable).

In the academic bachelor's program in the 4th semester of the Robotics study plan, Training Practice is included in the amount of 6 CP. The purpose of the Training Practice is to form students' initial professional practical skills, which are necessary for further activities, as well as the ability to independently make decisions in the specific field of professional work.

Students undergo training in TSI TERC laboratories. During the internship, students:

- get acquainted with the principles of organization and labor protection in TSI TERC laboratories;
- investigate the peculiarities of the functioning and use of equipment;
- explore the design of industrial and autonomous robots.
- learn industrial and autonomous robot programming;
- perform individual task.s

The Training Practice ends with the preparation of a report on individually completed tasks and a public presentation of the results.

The organization of Training Practice, its goals and tasks and achievable results are presented in the description of the study course Training Practice (see appendix 1.10).

As it has been already mentioned, the students do their internships in the TTI premises - TERC laboratories, and there is no difference in the organization of the internships between the local students and the foreigners. Moreover, the separate groups are not formed for study in English for local students and foreigners, they study in one group; they also learn the study course Teaching practice together.

3.2.5. Evaluation and description of the promotion opportunities and the promotion process provided to the students of the doctoral study programme (if applicable).

3.2.6. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the marks of the final theses.

The Bachelor's study programme "Robotics" was licensed full-time full-time and part-time part-time in Latvian and English in 2018, with the first intake of students in 2019/2020. The Robotics programme is a 4-year programme, so there are no graduates. The first thesis defences are scheduled for January 2024.

3.3. Resources and Provision of the Study Programme

3.3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples.

In the study direction report in sections 2.3.2. - 2.3.4 the full information on these issues is provided. This paragraph only provides additional and separate information and emphasis on the study programme.

The study process is mainly provided by the staff of the Faculty of Engineering of the TTI. In addition, the humanities and social studies part of the course involves staff from the Faculty of Transport and Management Sciences.

The Faculty of Engineering of the TTI provides teaching and methodological work: creates and updates course descriptions, provides teaching of relevant study courses (including practical, laboratory and seminar classes), conducts and defends bachelor theses and carries out other activities related to teaching, methodological and scientific work.

To provide students with practical experience, the laboratories of the TTI are used intensively during their studies. The laboratories are used for practical and laboratory work, and are also available to students outside study hours. During their studies, students of the Robotics programme can use the equipment and facilities of the 11 TERC laboratories, which ensure the implementation of the training programme.

The TERC Laboratories provide students with the opportunity to participate in in-house projects at the TTI by developing robotic devices for internal events such as robotics tournaments, Science Night, Open Day, exhibitions, etc. Students of the programme carry out research and development of robotic devices through coursework and group projects and undergraduate theses.

Students also have the opportunity to get involved in the activities of the research clusters and to implement projects that are more focused on research and development. With the active participation of the students of the programme, a prototype and a system for its management were developed within the project: Development of a Slot System for Multi-Complex IHC Histological Staining. As part of the project, students were also involved in the development of the control system: the development of the external panoramic camera of the FARO Laser Scanner. In 2022, three students from the Robotics programme carried out an independent development of robotic devices using TERC laboratory equipment and software as part of the IdeaHub project.

Information on the possibility of participating in projects or other activities is disseminated both on the TTI website and by involving students individually, taking into account their desire to gain practical experience. The TERC laboratories provide students with the opportunity to develop their professional competence in the field of robotics. Starting from November 2020, the TERC laboratories will provide students with the activity "Development of skills needed for work" under the ESF project "Support for the education of the unemployed" No 7.1.1.0/15/I/001. Three Robotics students undertook an additional internship using industrial robots in the TERC laboratory "Industrial Robots". As a result, they received offers to participate in projects of robotics companies

Robologic Ltd and Technomatic Ltd.

The common study, scientific, informational (including library), material-technical and financial base of the TTI and the Faculty of Engineering creates preconditions for the achievement of study results and proves the possibility of ensuring a quality study process for the study programme "Robotics". For the effective implementation of the study programme, the teaching staff and students at the faculty have access to classrooms equipped with the latest generation of visual and audio equipment, as well as highly certified and evaluated laboratories, which correspond to the specifics of the study programme and the conditions for its implementation.

In the reporting period, for the needs of the study field, the TTI has acquired infrastructure for laboratories, practical classes (e.g. modelling computer programs) and lectures (e.g. scientific literature, databases of scientific articles), computer equipment (monitors, computers, presentation lasers), laboratory equipment (for details, see Annex 9.Laboratories).

Students of the programme "Robotics" have access to the TTI library. In 2019, the STEM project purchased around 3,000 new books for a total of EUR 100,000 from various scientific publishers. For example: Springer, Tailor&Francis, Elsevier, etc. 90% of these books were purchased in electronic format and are available to users via the Library's electronic catalogue. In the following years, the Library's collection was updated annually with newer books. The Library has 29 890 documents available for the students of TTI, of which the following are specific to the field: books - 14 146, e-books - 2588, periodicals -1072; and the following databases are subscribed to: the AcademicComplete e-book database, where the number of books in the field of Robotics - 1035 titles. The availability of e-literature is particularly important for distance learning students.

3.3.2. Assessment of the study provision and scientific base support, including the resources provided within the framework of cooperation with other science institutes and higher education institutions (applicable to doctoral study programmes) (if applicable).

3.3.3. Indicate data on the available funding for the corresponding study programme, its funding sources and their use for the development of the study programme. Provide information on the costs per one student within this study programme, indicating the items included in the cost calculation and the percentage distribution of funding between the specified items. The minimum number of students in the study programme in order to ensure the profitability of the study programme (indicating separately the information on each language, type and form of the study programme implementation).

Since the establishment of the programme, tuition fee income has been the main source of funding for the study process.The study programme is financed from the financial resources of natural and legal persons.

For the academic year 2022/2023, the tuition fee for one full-time student is EUR 2200 per year, for a part-time student - EUR 1760 per year. The amount of tuition fee for each academic year is determined and approved by the Rector's Order. The tuition fee payment procedure is set out in the Regulations on Tuition Fee Payment Procedure, which provides for the possibility of paying tuition fees for the entire study programme, for one academic year, for one academic semester or as a monthly payment (starting from the 2nd semester).

Average costs in Annex 1.7. There is no difference in the cost of studies in Latvian and English, as the studies are provided at a high quality level without a breakdown by language of study, so there are no different tuition fees.

The cost structure of the study programme in the last academic year 2021/2022 shall include salaries and taxes (including costs of scientific publications, etc. (including the payment of teaching staff in accordance with the TTI Teaching Staff Remuneration Regulations) amounting to 53 %, study programme development and implementation costs amounting to 5 %, teaching materials and other similar costs amounting to 8 %, scientific infrastructure costs and other similar costs amounting to 9 %, advertising and marketing costs amounting to 9 %, infrastructure costs (including IT costs) 9%, depreciation and amortisation 5%, other administrative costs 2% .

Each year, TTI provides students with the opportunity to receive personalised discounts of 50%, 75% and 100% on full-time tuition fees, the discounts are granted on a competitive basis. Applicants are evaluated on the basis of the results of the National Centralised Examinations, the average grade of the certificate, motivation and other additional achievements. Students have the opportunity to obtain company scholarships, in the Robotics programme such scholarships are awarded by the company RobologicGmbH. Five scholarships from this company have been approved for the 2022/2023 academic year. These are not only scholarships, but also internships/working opportunities within the company itself.

To be profitable, the programme must have at least 10 students. It is taken into account that the programmes of the field of study respect the continuity of study courses, as well as the study plans of each programme are mutually coordinated - the courses included in the plan and their sequence by semesters. These are the general education courses of all the main study programmes of the field, such as Work Safety, Civil and Environmental Protection, Higher Mathematics, Probability Theory and Mathematical Statistics, Foreign Language, Programming, etc., but there are study courses taught in two programmes "Robotics" and "Computer Engineering and Electronics": Physics, Theory of Electrical Circuits, etc. Another example is courses taught in two different programmes "Robotics" and "Aeroengineering": Engineering and Computer Graphics, Technical Mechanics, Materials Science, etc.

Group of 10 students is given as the average number. As already mentioned, several courses are taught jointly for different programmes. In full-time face-to-face studies, the costs are higher, therefore a larger number of students is needed - 12, in part-time studies - 8. The language of study does not affect the amount of costs

This saves money and makes the programmes cost-effective with fewer students.

3.4. Teaching Staff

3.4.1. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on

how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The study programme is taught by 31 teaching staff with relevant academic experience and qualifications, 25 of whom are elected lecturers.

The compulsory and restricted optional parts of the Academic Bachelor's Degree in Robotics are delivered by 8 TTI professors, including 6 with PhDs in engineering: Dr.sc.ing. A.Grakovskis, Dr.sc.ing.I.Jackiva, Dr.habil.sc.ing.I.Kabashkin, Dr.sc.ing. M.Savrasov, Dr.sc.ing., D.Pavlyuk (second PhD in Economics), Dr.sc.ing.I.Pticina, PhD Merchan and Dr.sc.administr. J.Stukalina; and three associate professors Dr.sc.ing.A.Krainyukov, Dr.sc.ing. N.Spiridovska and Dr.sc. administr. I.Sproģe. Therefore, it can be concluded that the qualifications of the teaching staff involved in the implementation of the study programme fully comply with Article 55, Part 1 of the Law of the Republic of Lithuania "On Higher Education Institutions", which stipulates that not less than five professors and associate professors who have been elected to academic positions at the respective higher education institution participate in the implementation of the compulsory and restricted elective part of the academic study programme.

In addition to the above-mentioned professors, 10 associate professors, 3 lecturers and one research assistant, who is also a senior engineer at the TERC Centre, I.Laksa, are involved in the implementation of the programme.

A total of 21 or 84% of the academic staff involved in the programme have PhDs in science - 19 in engineering and 2 in social sciences.

The study process involves not only the academic staff of the field of study, but also a number of specialists in the field, including foreign teaching staff, who with their professional experience not only deepen the practical knowledge and skills of the students within the study course, but also increase the employment opportunities of students after graduation from the programme.

Currently, only two of the elected faculty members are working in companies in the field: S.Šarkovskis SIA Sonarworks, DSP Researcher; E.A.Merchan, Director of Engineering, Robotic Solutions.

N.Šļendins, lecturer at the National Defence Academy of TTI, teaches the course "Occupational Safety, Civil and Environmental Protection" to students of all streams.

Of the guest lecturers, 2 persons have PhD degrees, the others have Master's degrees.

Some courses have several lecturers or the main course is taught by the Programme Director, but it is already foreseen that for some topics, industry representatives will be invited as guest lecturers, thus ensuring both the quality and relevance of the course content.

To enhance the quality of the programme, lecturers teach courses in one of the two languages only. Lecturers carry out scientific research and participate in the education of students. The Institute of Transport and Communications ensures the professional development of its staff as far as possible and provides incentives with remuneration competitive in Latvia.

Foreign teaching staff: Merchan Emmanuel Alejandro Cruz (Robot Details and Mechanisms and Their Design, Kinematics and Dynamics of Robots) teach only in English in the study programmes for both students who study the programme in English and students who learn in Latvian, taking into account that the university has the right to implement no more than one-fifth of the credit points of the study programme in a foreign language (article 56, paragraph 3 of the Higher

Education Law, and paragraph 5.1.2 of the TTI study agreement).

The knowledge of the state language of the teaching staff involved in the programme complies with the Cabinet of Ministers' Regulation No 733 of 07.07.2008 "Regulations on the scope of knowledge of the state language and the procedure for testing the knowledge of the state language for the performance of professional and official duties, for obtaining a permanent residence permit and the status of permanent resident of the European Union, and the state fee for testing the knowledge of the state language". The TTI Human Resources Department verifies national language skills at the time of recruitment.

In order to verify the English language skills of the teaching staff, periodic English language proficiency tests and, if necessary, additional training are organised at the TTI, e.g. in the academic year 2019/2020, several of the teaching staff will improve their English language skills in the courses organised in the framework of the project 8.2.2, and repeated English language courses are planned in the future from the funding of the TTI itself.

The qualifications of the teaching staff involved in the implementation of the study programme meet the conditions for the implementation of the study programme and the requirements of the regulatory enactments, ensure the achievement of the objectives and study outcomes of the study programme and the corresponding study courses.

3.4.2. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

In the three years since programme "Robotics" was licensed, there has been little change in the faculty involved.

Position	2018 academic year			2021/2022 academic year		
Education	Doctor Degree	Master Degree	Total	Doctor Degree	Master Degree	Total
Professor	3		3	8		8
Associate Professor	4		4	3		3
Assistant Professor	9		9	10		10
Lecturer		1	1		4	4
Assistents		1	1			
Guest Lecturer	2	3	5	2	4	6

Total			22			31

As of the moment of licensing, 4 staff members are no longer involved in the programme: 2 guest lecturers have terminated their working relationship with the TTI, one assistant professor - due to retirement, one associate professor has been replaced by an assistant professor. During the reporting period, the programme has attracted new (elected by the TTI) lecturers teaching a specific course or a part of it. Of these, seven lecturers have doctoral degrees, two are professors, six are assistant professors and 3 are lecturers.

Currently, there are many young lecturers (up to 45 years). Several faculty members have increased their academic experience and have been elected to higher positions.Three faculty members from the licensing period of the programme have been elected to higher positions and have been elected to professorships - M.Savrasov, D.Pavlyuk and I.Pticina.

The choice of lecturers is determined by the content of the study programme, which is continuously improved in line with the rapid development of the ICT sector. The total number of teaching staff has increased due to the inclusion in the programme of study courses that provide students with scientific research skills, as well as the additional use of teaching staff specialised in the field, including from the professional environment: V. Gredasov, E. Merchan, M. Smolyaninov.

This allows to ensure the connection of the programme with practical activities, as the information is obtained directly from the professionals themselves, and arouses greater interest in the students.

In general, it can be concluded that the changes in the structure of the teaching staff involved in the study programme can be assessed positively, the relevant qualifications and experience of the teaching staff in academic work ensure a high quality of education and it is appropriate for the achievement of the overall results of the study courses and the programme.

3.4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals or peer-reviewed monographs may be additionally specified. Information on the teaching staff included in the database of experts of the Latvian Council of Science in the relevant field of science (total number, name of the lecturer, field of science in which the teaching staff has the status of an expert and expiration date of the Latvian Council of Science expert) (if applicable).

3.4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

3.4.5. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study programme and study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study programme has a mechanism for cooperation between teaching staff, which promotes the development and interconnection of study courses. The development of study courses is carried out on a regular basis, based on suggestions made by students, industry development trends, and the latest results of research, scientific activities and innovations.

During the implementation of study courses and scientific work, regular meetings of teaching staff are held to exchange experience on study course topics, results of scientific work, new developments in research, etc. Discussions are used to develop and improve the content of studies, with mutual agreement on topics, emphases, responsibilities and compliance with regulatory requirements.

The knowledge acquired in other study courses is taken into account in the design or development of the content of the study courses, indicating it as a prerequisite.

For example, in preparing the programme for evaluation, the content of the programme was reviewed and faculty members mutually agreed on the expansion of individual courses of study to reduce the number of small 2 CP courses in the programme as much as possible.

Given that study programmes are taught in several languages, the same course in Latvian and English is often taught by different faculty members to improve quality. All teaching staff involved in the course are involved in the course coordination process to harmonise the topics to be covered in the classes and to ensure common requirements. This ensures that the topics covered in the study programme are continuously developed and updated in close cooperation with each other. For example, assoc.prof. A.Krainyukov in cooperation with TERC engineer I.Laksa teaches the study courses Sensors for Robotic Devices, Metrology and Fundamentals of Electrical Measurements, Power Electronics Devices and Intelligent Robots. Another example, prof. A.Grakovskis in cooperation with TERC engineer I.Laksa lectures the study courses Electrical Circuit Theory and Electrical Machines in Robotics.

Hourly lecturers from the professional sphere are attached to the study programme, who lecture individual classes in existing study courses:

- A.Merchan: Robot parts and mechanisms and their design and Robot kinematics and dynamics;
- Sharkovsky: Electronic Devices in Robotics and Robot Control Methods;
- Gredasov: Industrial Robots, Industrial Robot Control Program Design and Industrial Robotics.

Within the study programme, cooperation with employers and professional organisations is carried out in seminars, conferences, as well as during personal contacts of lecturers, analysing the competence of students and graduates, as well as addressing issues of graduates' employability in the future.

The link with employers is also strengthened through the active participation of the study field staff in professional organisations and associations, the most important of which is the Latvian Information and Communication Technology Association (LIKTA), Latvian Electrical Engineering and Electronics Industry Association (LETERA), Mechanical Engineering and Metalworking Industry Association (MASOC), Remote Piloted Aircraft Association (LARPAS), Simulation Modelling Society, EuropeanConferenceof Transport ResearchInstitutes (ECTRI), Informatics Europeu

As part of the study process, preliminary defences are organised with the participation of a committee of faculty members and where recommendations for improving the bachelor thesis are collectively made. This ensures mutual cooperation between lecturers from different fields and allows for comprehensive recommendations for the development of bachelor theses. The same cooperation is observed after the defence of the bachelor thesis, when the Final Examination Board gives its evaluation as a result of the discussion, based on the evaluations proposed by the members of the Board. The committee is composed of senior faculty members and chaired by a company representative. It is planned that the Robotics Final Examination Committee will be chaired by a representative of Robologic.

Experienced researchers working at the Faculty of Engineering participate in research projects and activities funded by the Latvian Science Council, the European Commission and other international funding sources and foundations in collaboration with partners in universities and research institutions in Latvia, European Union Member States and worldwide: I.Kabaškins, I.Jackiva, M.Savrasovs, D.Pavlyuk, E.Merchan, A.Grakovskis.

The total number of lecturers involved in the implementation of the programme is 31, while the total number of students on 1 October 2022 was 32, thus the student-lecturer ratio is 1.

Annexes

III - Description of the Study Programme - 3.1. Indicators Describing the Study Programme		
Sample of the diploma and its supplement to be issued for completing the study programme	Annex 1.6 Sample of the diploma.zip	1.6.piel. Diploma paraugs.zip
For academic study programmes - Opinion of the Council of Higher Education in accordance with Section 55, Paragraph two of the Law on Higher Education Institutions (if applicable)	Annex 3.9 Opinion of the Council of Higher Education.docx	1.9.pielikums.TSI_Bak Robotika_250.edoc
Compliance of the joint study programme with the provisions of the Law on Higher Education Institutions (table) (if applicable)		
Statistics on the students in the reporting period	Annex 1.1 Statistics on the students.pdf	1.1.pielikums. Statistikas dati par studējošajiem pārskata periodā.pdf
III - Description of the Study Programme - 3.2. The Content of Studies and Implementation Thereof		
Compliance with the study programme with the State Education Standard	Annex 1.2. Compliance with the State Education Standard.docx	1.2.pielikums. Atbilstiba izglitibas standartam 3001 2.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard or the requirements for professional qualification (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Annex 1.3. Mapping of the study courses 2.xlsx	1.3.pielikums. Studiju kursu kartejums Bc Robotika.xlsx
The curriculum of the study programme (for each type and form of the implementation of the study programme)	Annex 1.4. The curriculum of the study programme.zip	1.4.pielikums. Studiju plans.zip
Descriptions of the study courses/ modules	Annex 1.5. Descriptions of the study courses modules.zip	1.5.pielikums. Studiju kursu apraksti.zip
Description of the organisation of the internship of the students (if applicable)	Annex 1.10. Training Practice.pdf	1.10.pielikums. Mâcîbu prakse.pdf
III - Description of the Study Programme - 3.4. Teaching Staff		
Confirmation that the academic staff of the doctoral study programme includes not less than five doctors, of which at least three are experts approved by the Latvian Council of Science in the branch or sub-branch of science in which the study programme intends to award a scientific degree (if applicable)		
Confirmation that the academic staff of the academic study programme complies with the requirements specified in Section 55, Paragraph one, Clause 3 of the Law on Higher Education Institutions (if applicable)	1.8..pielikums. Apliecinajums atbilstiba AL.docx	1.8.pielikums. Atbilstība AL.pdf