Scientific Activity Report

2021

This report provides information on the aims and objectives of the research activities for period, scientific outputs Transport and Telecommunication Institute – research papers, projects activities and initiatives, describes the local and international collaboration and knowledge events, as well as innovations and research to business and students works performed at the TSI.

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1. GENERAL INFORMATION

1.1. Mission, Vision

TSI new strategy for 2020 – 2025 has been adopted and designed to reflect TSI's ambition to be the leading private technical university in the Baltic Sea region and articulates TSI will make a difference to its students, to industry and to the higher education sector in the Baltic Sea region.
The mission of the Transport and Telecommunications Institute is to create and disseminate knowledge and make a positive difference to our community and the wider Baltic Sea region.

Our vision for the Research Strategy is:

Our developing research culture will dovetail with our approach to teaching, learning and assessment, with our research informing our teaching and providing opportunities for our students – both undergraduate and postgraduate – to engage with our research activity and our research-active staff. Our research activities will be critical to our ability to produce graduates who can address the industrial demands of the 4th industrial revolution and its impact on industries, markets and society.
The University Research Strategy is presented under five main objectives:

- **OBJECTIVE 1**
  To conduct high quality impactful applied research that will strengthen our reputation as the leading private technical university in the Baltic Sea Region.
- **OBJECTIVE 2**
  To develop internationally recognised research and innovation active staff.
- **OBJECTIVE 3**
  To create a critical mass of research-active staff and establish a pipeline of future research staff.
- **OBJECTIVE 4**
  To establish an appropriate number of focused, multi-disciplinary research clusters that address key issues facing society with the potential for national and international impact.
- **OBJECTIVE 5**
  To celebrate our successes and promote our achievements globally.

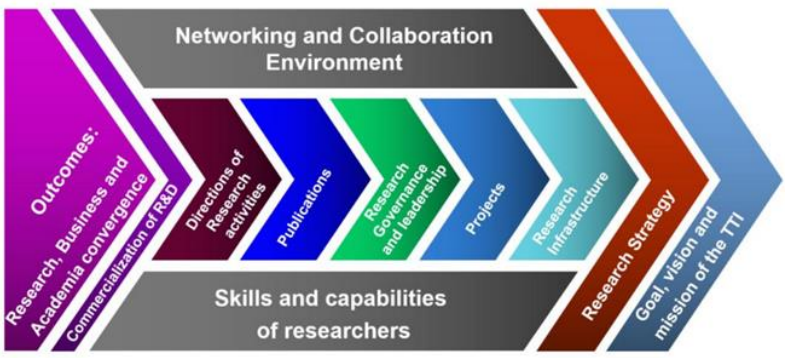


Figure 1 Framework for development of the research program of TSI

1.2. Research Infrastructure

The TSI research infrastructure managerial and policy-making institutions are the Board, Rector, Vice-Rector for Academic & Research. The advisory and supportive functions are delegated to the three Councils: PhD & Research Council, Professor Council, Promotion Council. The primary external advisory body for the research in the Institute is the International Scientific Advisory Board: Prof. Nicos Komninos (Greece), Prof. Michael Schenk (Germany) and Prof. Andres Monzon De Caceres (Spain). Their role is to review research activities, provide insights for the key developments and events, provide advice on the challenges, propose funding opportunities and act as ambassadors for the Institute.
The Research Administration Department aims to support high-quality academic, scientific and applied research through leading the implementation of research strategy and policies, ensuring compliance with research governance and quality requirements, supporting researchers to access funding as well as form new collaborations and consortiums, engaging with the development of research processes and advising on the administration and management process. TSI Research Administration Department supervises key research partnerships and activities with international and national partners, public and private sector corporate clients according to best project management principles to maximize their effectiveness and works with a range of stakeholders to identify and realize new research opportunities.

All 17 laboratories of the TSI work in close collaboration with the management and Research Administration Department, Faculties and Research Clusters. The Figure 2 below presents a schematic structure of the research & development infrastructure of the Institute:

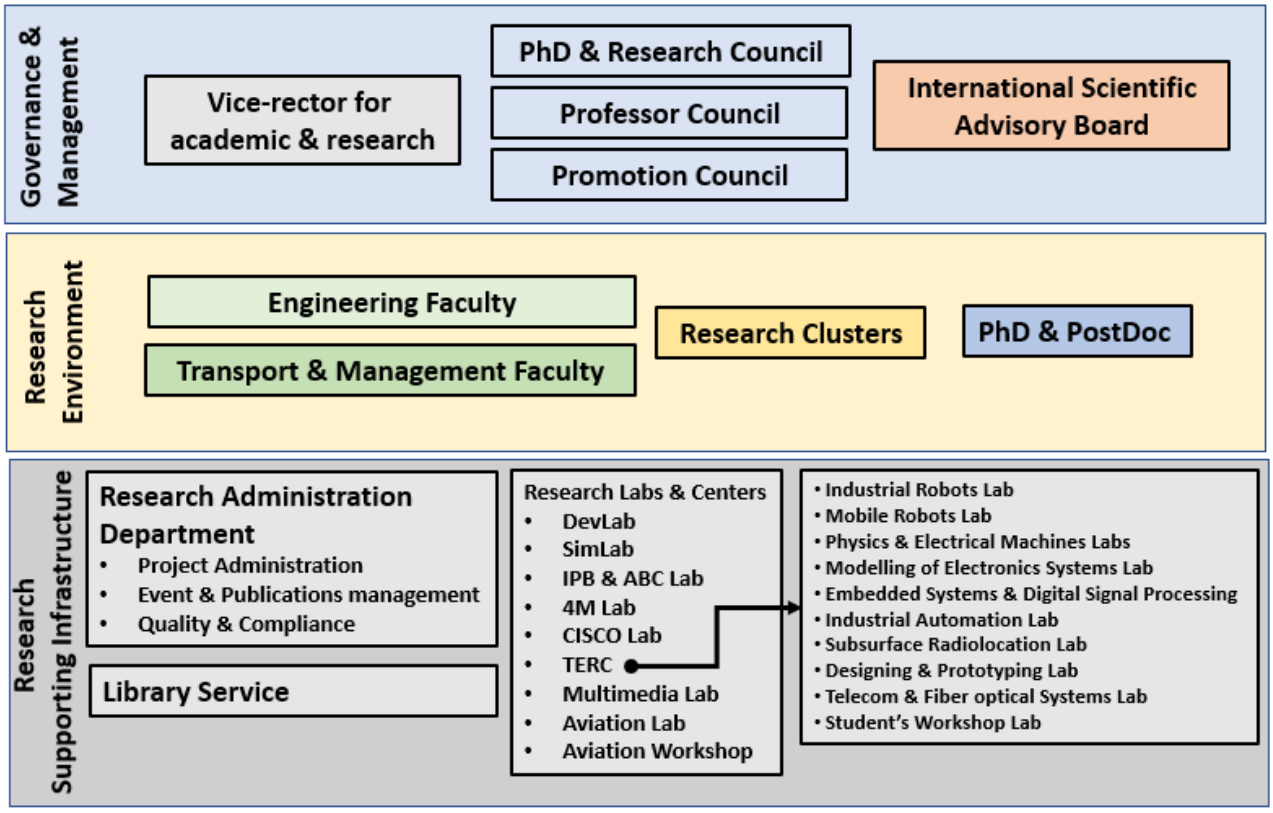


Figure 2 Research Infrastructure

The three new laboratories had been opened in the framework of the Centre in 2018 - Laboratory of Industrial Robots; Laboratory of Mobile Robots and Software and information system development laboratory, DevLab. The Industrial and Mobile Robots Labs were opened within the framework of the project No. 8.1.1.0/17/I/009 "Modernisation of Transport and Telecommunications institute STEM study programmes"; DevLab is TSI investment project for the development of applied research in the field of information technology and computer science; development and support of research at the Computer Science and Telecommunication Faculty as well as the implementation of TSI projects and applied research.

Laboratory of Industrial Robots
The laboratory is equipped with 4 industrial robots: the KUKA KR16 robot, the ABB IRB6600 robot, and two KUKA KR125 robots. The laboratory has a functioning segment of an automated production conveyor line, which includes sensors, actuators and control systems based on programmable logic controllers. The laboratory is intended to study the principles of design, operation and use of industrial robots in order to acquire the ability to program industrial robots to perform typical technological operations of robotic production.

Laboratory of Mobile Robots
Within the STEM project additional robotic arm setup consisting of “Universal Robots U3” (with gripper tool and camera) was added to the equipment of TSI in 2018 to provide learning opportunities for students to practise applied programming for industrial processes. Within the same project laboratory additionally was equipped with robots of the following brands: NAO 6 humanoid robots (6 pcs.), Khepera IV compact mobile robots (8 pcs.), Koala 2.5 mobile robots (3 pcs.). The personal computers of the laboratory have the software necessary for programming these robots. The laboratory is intended to study the principles of programming mobile robots, to implement and study existing and developed robot control algorithms: environment mapping algorithms, route planning and navigation algorithms, object detection and recognition algorithms, remote algorithms, artificial intelligence algorithms, etc.). Laboratory robots and software allow to learn the principles of creating mobile robots, to understand the features of the use of mobile robot information devices and to develop practical skills in the implementation of mobile robot control algorithms.

All laboratories are equipped with the latest software and hardware. They are widely used in academic and research activities of the Institute. Each laboratory is a collection of contemporary technical, software and methodological equipment and materials, which allows conducting classes with students at the edge of innovative research. Apart from the above-mentioned laboratories of Industrial Robots and Mobile Robots, the following laboratories are parts of the TERC.

Laboratory of Physics and Electrical Machines. The laboratory is equipped with training equipment of the company PHYWE, which helps exploring the effect of the fundamental laws of physics. At the same time, the electrical machine equipment from the manufacturer K&H MFG, helps to understand the principles and work of modern electric motors.

Laboratory of Modelling of Electronic Systems. The laboratory is equipped with a wide range of applied software allowing simulation of the work of electric circuits and the designing of printed circuit boards. The list of available programs consists but not limited to: Electronic Design Automation package OrCAD; Functional Modelling (Simulation) System Proteus VSM; Modelling (Simulation) System of Industrial Standard NI Multisim; Graphical Programming System NI

LabVIEW; Designing System for Microcontrollers AVR Studio; Designing System for PLIC (programmable logic integrated circuits) Xilinx ISE WebPACK.

Laboratory of Embedded Systems and Digital Signal Processing. The laboratory is equipped with special debug kits with modern microcontrollers such as AVR, Freescale, STMicroelectronics, as well as programmable logic circuits XILINX. The equipment of laboratory allows designing and exploring digital signal processing systems and intelligent control systems.

Laboratory of Industrial Automation. The laboratory is equipped with Siemens control software systems and models of the production lines. The laboratory is designed for the research of the principles of industrial networks and engineering of the systems of automation based on industrial logic controllers. Industrial manipulator Kawasaki RS03N allows learning the principles of programming of industrial robots and exploring the features of integration of the robotic devices into the automated production lines.

Laboratory of Subsurface Radiolocation. The laboratory is equipped with the ground penetrating radar of the company GSSI and a set of options for the research of the roadbed. There is software RADAN 7, for processing the data of ground penetrating radar, installed in the laboratory. All the equipment of the laboratory allows exploring the methods of non-destructive quality control of road surfaces and carrying out of work to assess the quality of the laying road surfaces and detection of hidden engineering communications.

Laboratory of Robotics and Students' Research Work. The laboratory is equipped with a variety of modern measuring equipment made by the company HAMEG and a set of debug modules for microcontrollers, PLIC and signal processors. Software and hardware platform NI ELVIS II allow carrying out the research of the operation of electronic devices through physical, semi-natural and mathematical simulation. The laboratory contains a set of functional units of the robots from LEGO, Lynxmotion, Pololu and Parallax, which allows to create autonomous mobile robots and learn the principles of the construction of control systems of robotic facilities in the laboratory.

Laboratory of Designing and Prototyping. The laboratory is equipped with software and hardware of production the prototypes of the electronic devices, including CNC machine tool LPKF Protomat S63 to produce double-sided printed circuit boards. Soldering Equipment of the laboratory allows to carry out montage using PTH (Pin Through Hole) and SMT (Surface Mount Technology) technologies.

Laboratory of Telecommunications and Electro-Optical Systems. The laboratory is intended for students to explore the principles of the construction of telecommunications equipment: Global System for Mobile communications (GSM); Global Positioning System (GPS); Radio-Frequency Identification System (RFID); Optoelectronic Systems; Digital Telephone Networks; Radio Transmitting and Receiving Devices; Antenna-Feeder Devices.

Laboratory of Electronics. This laboratory is equipped with type setting fields for creating electrical circuits. All the research work is with the use of specialized laboratory measuring equipment.

Aside the Robotics Centre, six other laboratories function as part of the Transport and Telecommunication Institute. These six laboratories listed below encourage students engage in high-quality innovative research in the fields of IT, Digital Economy and Telematics:

Laboratory of Applied Software Systems of the Transport and Telecommunication Institute carries on research and offers consulting in the following fields: traffic, logistics and business processes. The research and analysis are fulfilled using nowadays simulation software. The software of the laboratory allows to do the high-quality, representative and many-sided analysis of the research systems. Such projects as the projects connected with the new bus station in Riga, three level flyover of South bridge model, Liepaja city traffic macroscopic model can be mentioned as a vivid example (see more on website las.tsi.lv).

Multimedia Laboratory. The laboratory is equipped with videorecording and editing equipment complex, which allows creating educational, informative and commercial videos. The filming process of video lectures for the purposes of distance studying, sound recording for video materials and their preparation for placing into e-studying environment takes place at the filming studio. Moreover, the conference presentations and lectures of the lecturers and guest lecturers are being broadcasted live on the internet.

Learn_IT Project Laboratory. The main goal of this Laboratory would be to test a set of tools that will help to increase the effectiveness of learning by supporting the high level of concentration in a manner adapted to the individualized rhythm of learning. The solutions offered under the framework of LEARN IT project may be a good alternative for traditional ways of stimulation of concentration and focus during the process of learning. The Learning Lab with software for mobile devices was developed so that it can be used to prepare personalized recommendations for each person who will be tested in this Laboratory.

4M Laboratory, which provides access to the students and staff of TSI to the latest literature and scientific journals. The library has electronic catalogue of all information entities and it is possible to search the necessary information via internet.

IPB & ABC Laboratory - Image Processing, Biometry & Automated Border Control Systems. Since 2017 TSI in cooperation with one of the industries & business leader – company X-InfoTech organized a new modern research laboratory. Analysis and processing of images (the same as - pattern recognition, machine vision, Image Processing, Pattern Recognition, etc.) is a modern trend - scientific direction supporting a huge number of applications related to monitoring objects and territories, medicine, artificial intelligence, security systems.

DevLab - Software and information system development laboratory. DevLab is challenge-based laboratory of Computer Science and Telecommunication Faculty, targeted on organizing creative teams of developers who able to deliver smart software solutions to industry, based on cutting-edge technologies. Laboratory unites researchers, students and industry to create innovative solutions, develops new industry-demanded skills in the area, empowers start-up thinking and makes any students ideas possible. We are giving unique possibility for students to be involved in real software development projects and develop own practical skills, staying in campus and receiving support from leading teaching and research staff of TSI. In our projects we are feeding software, web apps, mobile applications and robots with artificial intelligence, forecasting methods, natural language processing, chatbots, behavioral models, advanced data analysis, augmented realty, image and video processing.

1.3. TSI Research Clusters

TSI Research Clusters are recognised group of researchers whose research expertise is applied either to a common field or who are involved in collaborative research projects.

Research Clusters' Purpose

- Bring together and provide a supportive and stimulating collegial context for researchers, postgraduate students, and postdoctoral fellows working on topics of common interest, with the aim of increasing the research outputs of the TSI.
- Attract internal and external research funding for collaborative research, with the aim of being upgraded to a Research Theme or a Research Centre funded by the University.
- Generate, and promote awareness of, research opportunities for potential postgraduate students, and for research collaborations with staff and students in TSI and other universities.

Data Analytics and Artificial Intelligence research cluster

The Data Analytics and Artificial Intelligence research cluster is focused on data-based research, consultancy and training, including big data analytics, statistical modelling, natural language processing, and major aspects of artificial intelligence. The cluster's activities fill the gap between cutting-edge research and businesses across industries and sectors.
Applied areas of the cluster include (but not limited to) air transport industry, urban traffic flows, public transport, social media, spatial planning, inventory control and logistics.

Modelling-Based Systems Analysis and Design (MADSYS)

Modelling-Based Systems Analysis and Design Cluster – perform research and offers consulting in the following fields: traffic, logistics and business processes. Research is carried out using Clusters labs – for example – SimLab, with modern PTV software tools: Vissim; Visum. Lab equipment as well as highly qualified (certified) and skilled research-staff allows to perform high-quality, representative and many-sided analysis of the research systems. Lab main research activities & directions:

- Transport systems, traffic, logistics and business processes modelling and analysis using software tools PTV Vissim including simulation of complex vehicle interactions realistically on a microscopic level
- Traffic planning and design, traffic analyses, forecasts and GIS-based data management, planning public transport services, developing advanced and future-proofed transport strategies and solutions using PTV Visum tools

1.4. Research Journals

Transport and Telecommunication Scientific Journal

Journal "Transport and Telecommunication" is a peer-reviewed open-access scientific journal, owned by Transport and Telecommunication Institute. This Journal is a source of information and research results in the full scope of transport science: modelling and planning the transport systems, technical means of transport; transport infrastructure, traffic control, intellectual transport system, telematic and also concerns the interdisciplinary questions: transport and the environment, safety in transport, quality and effectiveness of transport, interoperability and intermodality. The journal aims at addressing professionals in transport and telecommunication in different types of positions in the area of industry, research and academic institutions. The Journal is published quarterly in the electronic and printed version.

The papers published in Journal "Transport and Telecommunication" are included in the following scientific databases:

SCOPUS (since 2008, Vol. 9, No 1), Elsevier Database; 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 Infrastucture); EBSCO Discovery Service; Google Scholar; Primo Central (ExLibris); SCImago (SJR), and many more.

The Figures below demonstrated the development process of the journal. The data are obtained from the Scimago Journal & Country Ranks (http://www.scimagojr.com/):

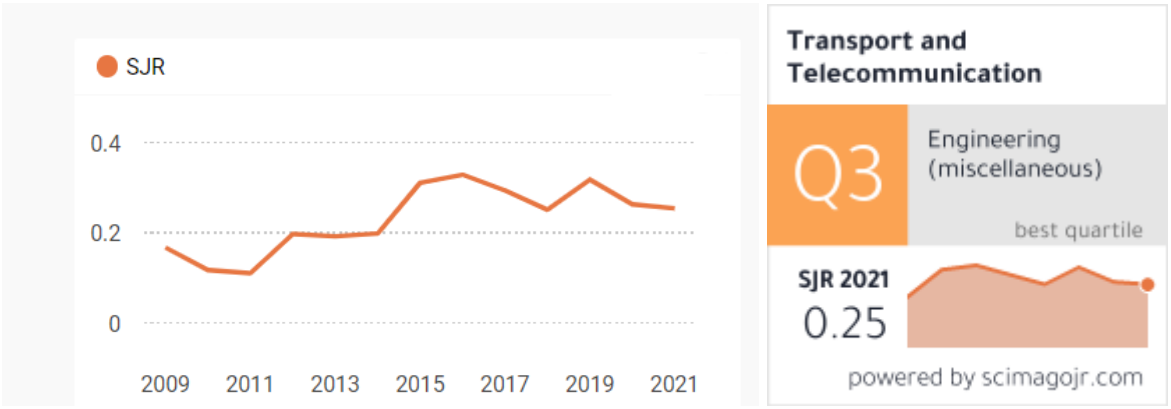


Figure 3 Transport and Telecommunication Journal performance (Scimago)

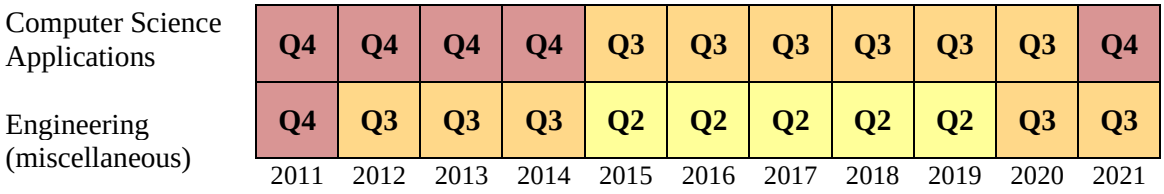


Figure 4 Transport and Telecommunication Journal performance (Scimago) (2)

The significant improving in journal position based on the KPI values included in following Table: (Table 1).

Table 1

Journal position based on the KPI

KPI	2021[1]
H-index of the Transport and Telecommunication Journal	**16**
SJR indicator	0.25
Cites per document (3 years)	1.682
International Collaboration	27.03%
Change the quality of the journal in following categories[2]: • Computer Science application • Engineering (Miscellaneous)	 Q4 Q3

[1] Based on data from SCImago Journal & Country Rank http://www.scimagojr.com/ (data available for the year 2021)
[2] Based on data from SCImago Journal & Country Rank http://www.scimagojr.com/ (data available for the year 2021)

Aside from "Transport and Telecommunication" journal, the TSI publishes a scientific peer-reviewed journal "**Computer Modelling and New Technologies**", which is also a quarterly scientific & research journal, ISSN 1407-5806, ISSN 1407-5814.

1.5. Research Staff

The research staff of TSI is registered in VIAA (State Education Development Agency Republic of Latvia) research staff database.

Figures 5 and 6 show the dynamics regarding research staff in TSI staring from 2016:

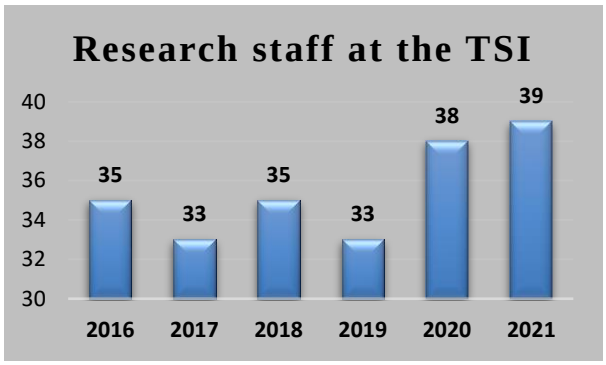


Figure 5 Research staff at the TSI

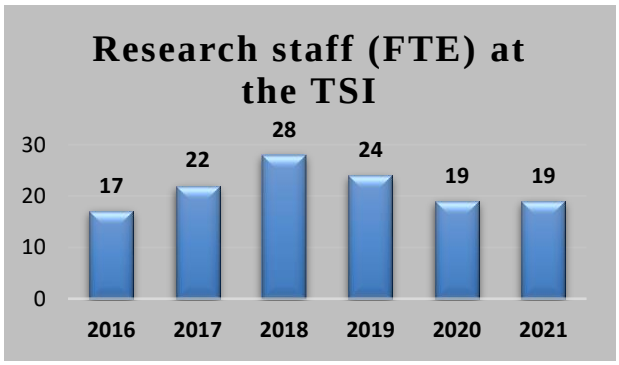


Figure 6 Research staff (FTE) at the TSI

Figure 7 shows the distribution of staff by type at the TSI:

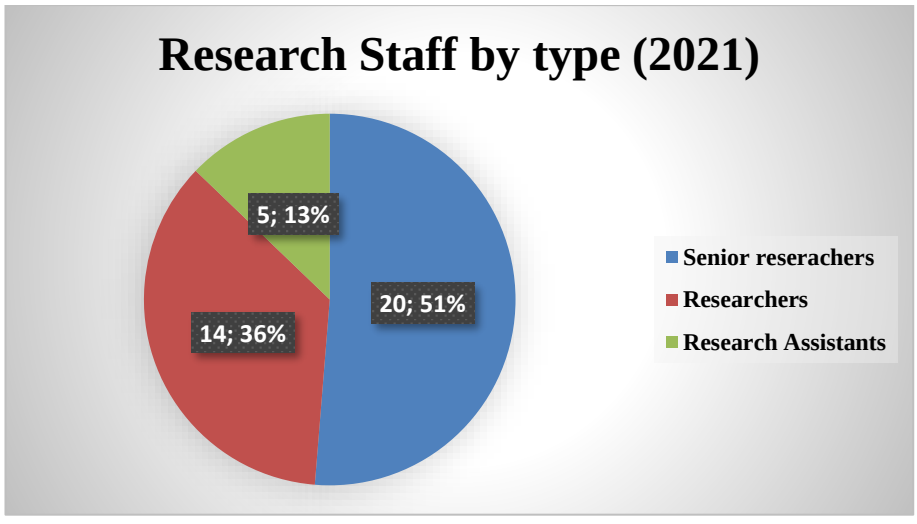


Figure 7 Research staff by type

2. RESEARCH OUTPUT

2.1. Number of scientific publications and other outputs

Table 2

Scientific publication / outputs, 2021

1. Original articles in anonymously refereed scientific journals cited in Web of Science & SCOPUS	32
2. Articles in other refereed scientific edited journals and conference proceedings	16
3. Monographs published[3]	0
4. Other scientific publications - proceedings[4]	4
5. Textbooks and other research-related publications	0
6. Patents/ including international	0
7. Computer programs and algorithms[5]	0
8. Registered cultivars	0
9. Conference abstracts	40
10. Visiting lectures/Online lectures	3
11. Articles, radio and television programs and journals popularizing science	5
12. Other[6]	0

Figure below shows publication statistics for the last seven years:

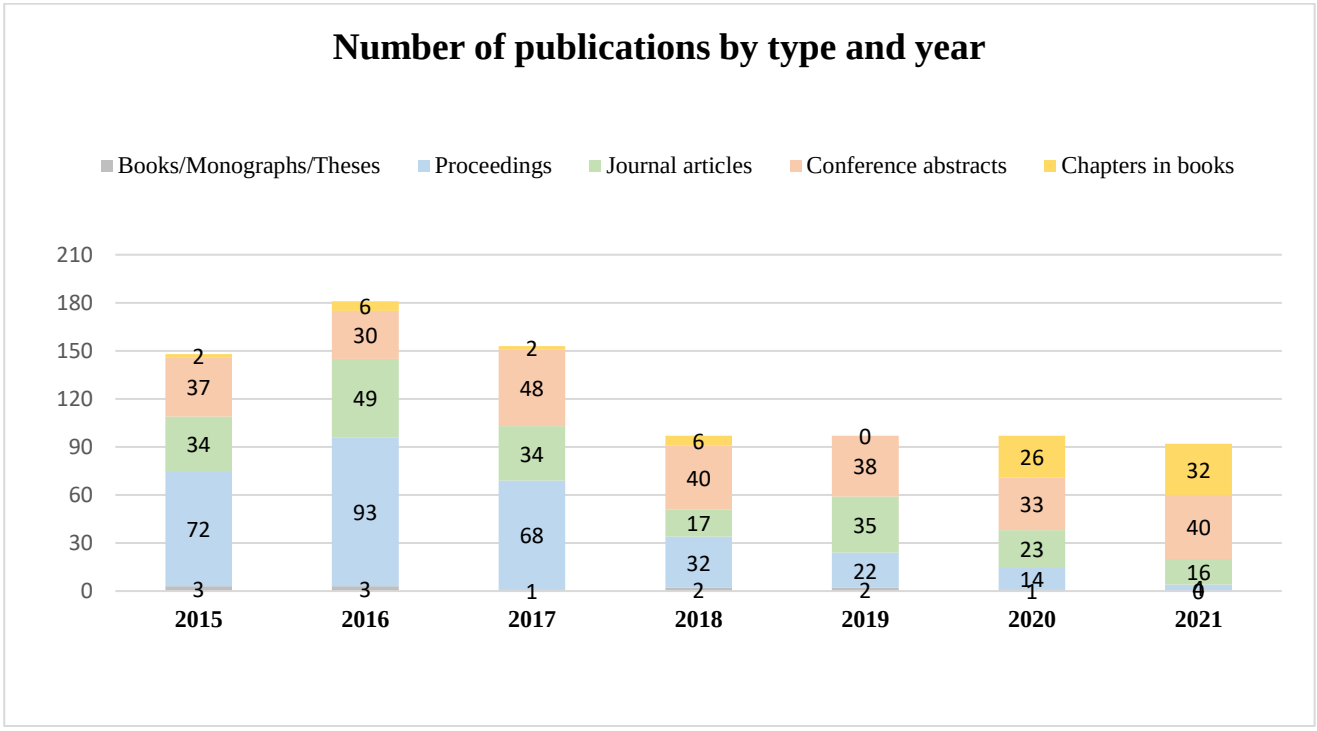


Figure 8 Publication performance and dynamics

[3] Includes doctoral theses and monographs.
[4] Includes edited proceedings, collections and special issues of scientific journals, and unrefereed scientific articles, excluding conference abstracts, chapters in books.
[5] Approximates the number of programs and algorithms that have been in use outside the unit.
[6] May include design products, prototypes, artefacts, exhibitions, performances etc.

2.2 Research Performance, based on Scopus Data

Table 3

Overall research performance

277 ▼ Scholarly Output 30.0% Open Access	92 ▲ Authors	0.75 Field-Weighted Citation Impact
758 Citation Count	2.7 Citations per Publication	12 *h*5-index

Note: This analysis provides an overall metrics summary of the institution. The snowflake means the metrics have been calculated using the Snowball Metrics methodology.

Publications by Subject Area

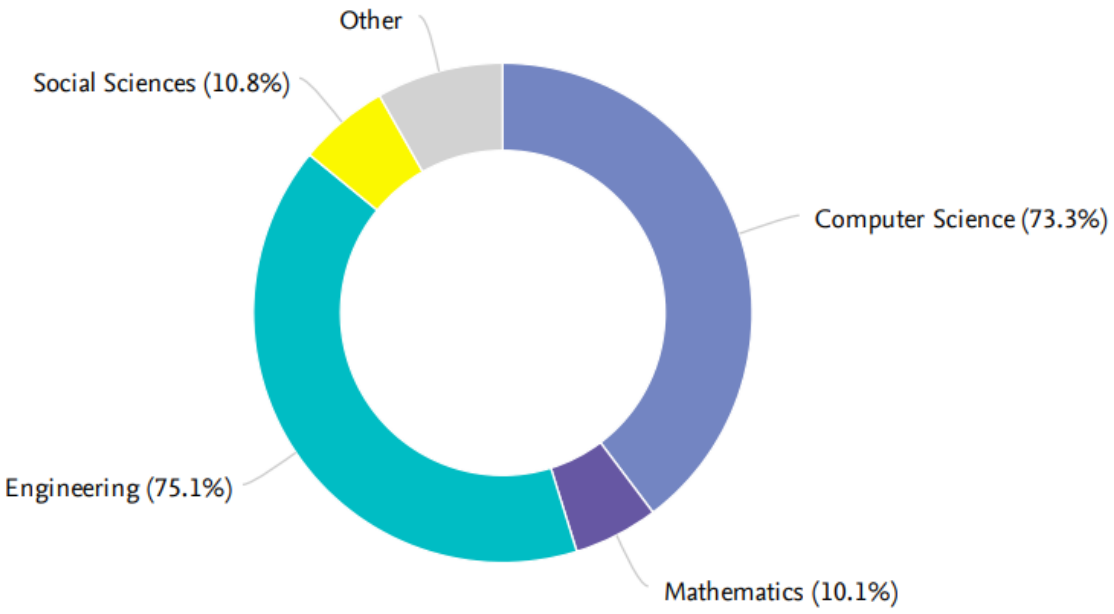


Figure 9 Publications by Subject Area

Field-Weighted Citation Impact

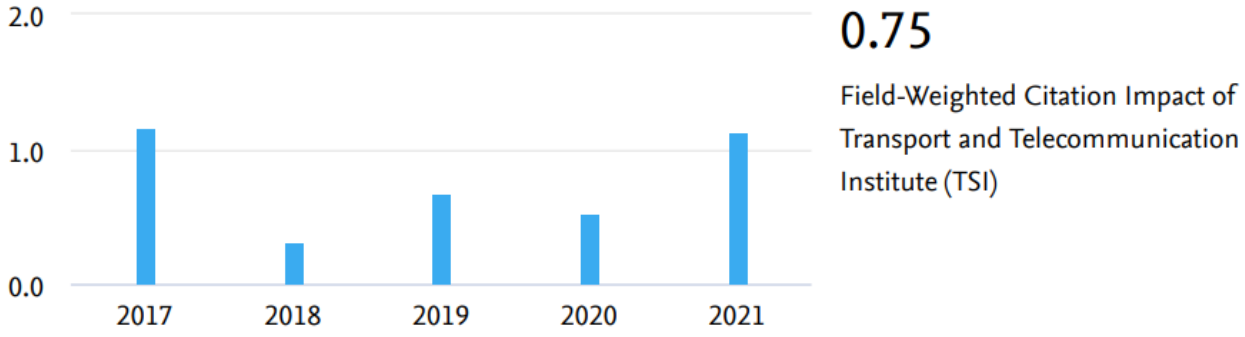


Figure 10 Field-Weighted Citation Impact

Note: Field-Weighted Citation Impact (FWCI) indicates how the number of citations received by the institution publications compares with the average number of citations received by all other similar publications in Scopus. A FWCI of 1.00 indicates that the institution's publications have been cited exactly as would be expected based on the global average for similar publications. A FWCI of more than 1.00 above average citations; for example, 2.11 means 111% more than the world average.

Collaboration

Scholarly Output at Transport and Telecommunication Institute (TSI), by amount of international, national, and institutional collaboration

Metric		Scholarly Output	Citations	Citations per Publication	Field-Weighted Citation Impact
International collaboration	35.7%	99	268	2.7	0.72
Only national collaboration	19.1%	53	131	2.5	0.59
Only institutional collaboration	23.5%	65	174	2.7	0.80
Single authorship (no collaboration)	21.7%	60	185	3.1	0.91

Figure 11 Scholarly Output

Note: Indicates the extent to which the institution's publications have international, national, or institutional co-authorship, and single authorship. A publication is assigned a single collaboration type.

Top collaborating Institutions

	Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citation Impact
1	University of Latvia	24 ▲	59	13 ▼	0.51
2	University of Thessaly	20 ▼	42	8 ▼	0.54
3	Fraunhofer Institute for Factory Operation and Automation	12 ▼	40	12 ▼	0.87
4	Riga Technical University	9 ▼	35	11 ▼	1.06
5	Keio University	8 ▲	2	3 ▲	0.06
6	Vilnius Gediminas Technical University	7 ▲	5	5	0.14
7	TransfoElectric SIA	6 ▼	18	3 ▼	0.83
8	RISEBA University of Applied Sciences	4 ▲	26	3	1.02
9	Otto von Guericke University Magdeburg	3	28	4	1.64
10	University of Duisburg-Essen	3 ▲	9	3 ▲	0.47

Figure 12 Top collaborating Institutions

Note: Shows the top institutions that have co-authored scholarly outputs with the institution.

Share of publications at Transport and Telecommunication Institute (TSI) that are among the most cited publications worldwide

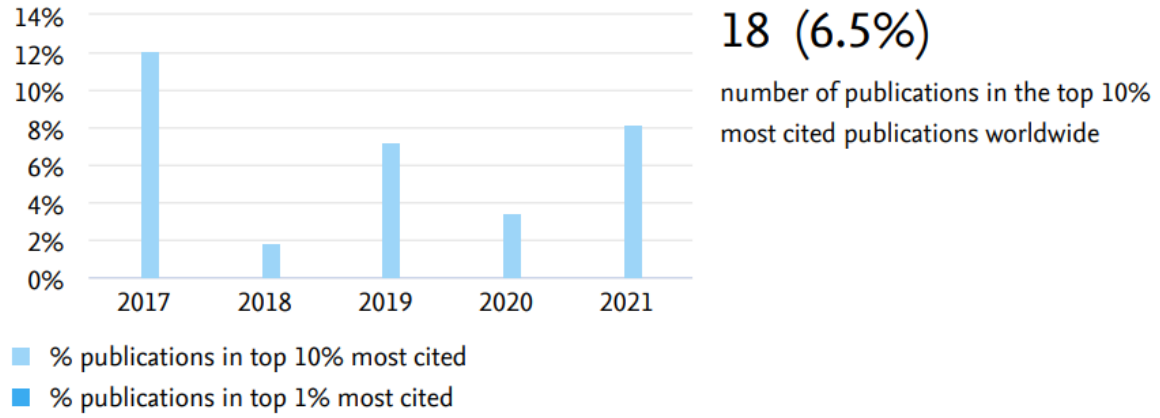


Figure 13 Most cited publications worldwide

Note: Outputs in Top Citation Percentiles indicates the extent to which an institution's publications are present in the top 10% most-cited percentiles within Scopus. This number is then field weighted to normalize for differences in subject area citation patterns.

Top Authors

Name	Scholarly Output	Most recent publication	Citations	*h*-index
1. Kabashkin, Igor	31	2021	52	8
2. Yatskiv (Jackiva), Irina	30	2021	80	7
3. Pavlyuk, Dmitry	20	2021	81	7
4. Savrasovs, Mihails	17	2020	48	6
5. Kuzmina-Merlino, Irina	15	2021	77	4
6. Nechval, Konstantin N.	15	2021	40	10
7. Tolujew, Juri	15	2020	70	11
8. Jackson, Ilya	13	2021	39	4
9. Andronov, Alexander M.	13	2021	8	5
10. Grakovski, Alexander	12	2021	18	5

Figure 14 Top Authors

Note: The authors with the highest scholarly output from the institution, along with some metrics about them.

3. MASTER, PhD STUDENTS AND POSTDOC ACTIVITIES

3.1. Number of students

Table 4

Master and Doctoral degree students

Position	2021
Completed their master's degree	57
Enrolled in doctoral studies	7
Active doctoral students	19

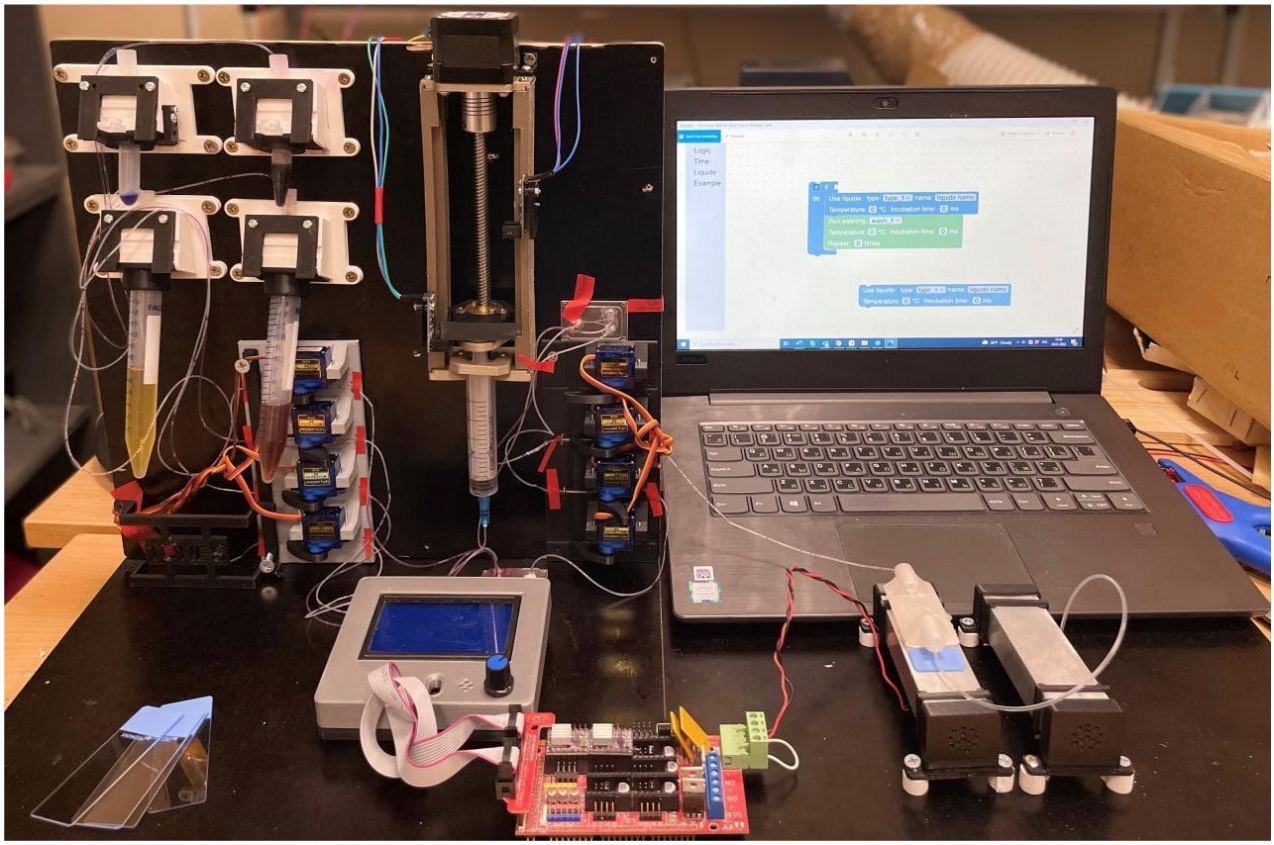
3.2. Students research work

TSI Involves students in research, starting from the first year

DEVELOPMENT OF THE SLOT SYSTEM FOR MULTIPLEX IHC STAINING

The industry representatives "Argento Lab" come to Transport and Telecommunication Institute (TSI) with an idea how the develop the core of the system, the slot for the staining process and the systems that ensure staining processes in the slot. The core of the system is some cell in which the interaction of liquids with the sample takes performed.
The goal of the project is the design and development of a compact system of slots – that will be as a core for the staining cycle of histological materials (auto-stainer).
The main purpose of the slots system is to provide automated immunohistochemical staining of histological sections (samples).
TSI has involved students and leading researchers to provide the solution.

Ivans Gercevs (*study Robotics, BSc, engineer at Telecommunications, electronics and robotics center*) developed technological prototype of the IHC multiplex sample staining slots system, based on microfluidic (or equivalent) technologies.



3.3. Scope of PhD program activities

TSI PhD Degree Programme "Telematics and Logistics" is a long-standing successful state-accredited third level higher education programme.

In 2021, 7 new candidates were accepted to the PhD program of TSI: Bodrova I. (supervised by Kabashkin I.), Shoshin L. (supervised by Kabashkin I.), Kharlov A. (supervised by Tolujev J.), Sidorec A., (supervised by Tolujev J.), Larina J. (supervised by Pavlyuk D.), Veselij A. (supervised by Savrasovs M.), Bulyaeva M. (supervised by Stecenko I.).

3.4. Scope of PostDoc program activities

In 2021 there was one ongoing post-doc project with the budget total of 124769.71 euro for each of the projects, 5% of the financing coming from the Institute in form of salaries for consultants and infrastructure expenses.

This Postdoc project is:
1) “Model of Smart Economy in a Smart City” (started 01.06.2020.)
The project is dedicated to the development of a smart economy model in a smart city, which assumes that some elements of the market economy are replaced by “smart” ones. For example, the share economy can be considered as smart elements, successfully implemented in urban life.

In 2021, **Dr. Jelena Popova** participated in following conferences:

- The 63rd INTERNATIONAL SCIENTIFIC CONFERENCE OF DAUGAVPILS UNIVERSITY, (Daugavpils, Latvia).
- The 21st International Multi-Conference Reliability and Statistics in Transportation and Communication (Relstat'21), (Riga, Latvia).
- The 7th International Scientific Symposium "Economics, Business & Finance", (Riga, Latvia).
- Plenary Session of Scientific and Practical Conference "Sustainable Development and Green Economy", (Bishkek, Kirgizstan).
- The VII International Scientific and Practical Conference "Quality Management: Search and Solutions", (Houston (TX, USA).
- The IX International Scientific and Practical Conference "Management Sciences in the Modern World", (Moscow, Russia).
- The International Scientific Conference "Development of Modern Economic Science in the Context of Digitalization", (Kiev-Riga, Ukraine-Latvia).

TSI has received the Erasmus+ Charter for 2021 – 2027

Transport and Telecommunication Institute (TSI) is glad to announce that our application for the extension of the Erasmus+ Charter for Higher Education (ECHE) has been approved with the maximum possible assessment score given by the international experts (100%).
This decision confirms that TSI has been following and fulfilling all necessary requirements and guidelines set by the European Commission for the realization of the Erasmus+ programme projects.
The Erasmus+ Charter for Higher Education (ECHE) provides the general quality framework for European and international cooperation activities a higher education institution may carry out within Erasmus+. The award of an ECHE is a pre-requisite for all higher education institutions willing to participate in learning mobility of individuals and/or cooperation for innovation and good practices under Erasmus+ programme.
TSI has received a new Erasmus+ Charter for Higher Education (ECHE) valid for 7 years, from 2021 to 2027.

4. CONFERENCES AND OTHER SCIENTIFIC EVENTS

TSI continues to hold regularly local and international conferences. The most significant among them is the TSI's Annual International Conference "Reliability and Statistics in Transportation and Communication". In 2021 RelStat-21 Conference was held on 14-15 October 2021. The total number of participants in 2021 were 73 authors from 16 countries (China, Estonia, Finland, Georgia, Germany, Greece, Japan, Kazakhstan, Latvia, Netherlands, Poland, Russia, Saudi Arabia, Slovakia, Switzerland, Ukraine) presented their research and shared the knowledges.
The Conference Proceedings of 2021 were published in Springer as well as Indexed in Web of Sciences.

Table 5

Scope of Conferences

CONFERENCES					
Conference	**Date**	**Total participants**	**Given Presentations**	**Total Authors**	**Countries**
Annual International Conference "Research and Technology – Step into the Future" (Spring)	23/04/2021	62	44	43	Latvia, India, United States, Estonia
Annual International Conference "Research and Technology – Step into the Future" (Autumn)	03/12/2021	33	15	18	Latvia, Russia
International Multidisciplinary Conference "Reliability and Statistics in Transportation and Communication (RelStat-2020)"	13/10/2021-16/10/2021	73	69	122	China, Estonia, Finland, Georgia, Germany, Greece, Japan, Kazakhstan, Latvia, Netherlands, Poland, Russia, Saudi Arabia, Slovakia, Switzerland, Ukraine

Table 6

Scope of Workshops/Seminars and Guest Lectures

WORKSHOPS/SEMINARS/GUEST LECTURES	
Event	**Period**
Guest lecture "Cloud Integration. How to create my first professional API" was held in Transport and Telecommunication Institute by representatives of the Accenture Latvia.	10/04/2021
An online discussion "Contemporary Challenges in Supply Chain Management and Development Opportunities" was held in Transport and Telecommunication Institute by representatives of Kreiss, Containerships GEFCO, MSC and HZ University of Applied Sciences.	18/05/2021
Online Guest lecture was held in Transport and Telecommunication Institute by representatives of the Clarity in frame of the Welcome Week.	20/09/2021
Online Guest lecture was held in Transport and Telecommunication Institute by representatives of the Accenture Latvia in frame of the Welcome Week.	21/09/2021
Online Guest lecture "Darbs Lursoft" was held in Transport and Telecommunication Institute by representatives of the Lursoft Latvia in frame of the Welcome Week.	21/09/2021
Online Guest lecture was held in Transport and Telecommunication Institute by representatives of the Swedbank in frame of the Welcome Week.	22/09/2021
Online Guest lecture "Darbs Lursoft" was held in Transport and Telecommunication Institute by representatives of the Lursoft Latvia.	28/09/2021
Online Guest lecture "Cloud Integration" was held in Transport and Telecommunication Institute by representatives of the Accenture Latvia.	27/10/2021
Online Guest lecture "Behind the scenes of real IoT" was held in Transport and Telecommunication Institute by representatives of the 1NCE.	10/11/2021
Online Guest lecture "Shipping Industry - introduction" was held in Transport and Telecommunication Institute by representatives of the MSC Shared Service Center Riga.	24/11/2021
Online Guest lecture was held in Transport and Telecommunication Institute by representatives of the Containerships.	08/12/2021
Online Guest lecture "Information systems in the aviation industry and requirements for IT specialists" was held in Transport and Telecommunication Institute by representatives of the S7 ENGINEERING.	08/12/2021
Online Guest lecture "Digitalization in the area of maintenance, repair, and continuous airworthiness of aircraft" was held in Transport and Telecommunication Institute by representatives of the S7 ENGINEERING.	08/12/2021

5. NATIONAL AND INTERNATIONAL COLLABORATION

Table 7

Scope of national and international collaboration

ORGANIZATION	COLLABORATION
National Research Organizations	**Type of collaboration / projects**
Institute of electronics and computer science	- Cooperation agreement
National Universities	**Type of collaboration / projects**
Riga Technical University	- Common Project Participation (EduRail); - Participation in Doctoral Review Committee - Joint Robotics Championship organisation
Rēzekne Academy of Technology	- Joint Robotics Championship organisation
University of Latvia	- Joint scientific articles - Participation in "RelStat 21'' Programme Committee
Vidzeme University of Applied Sciences (ViA)	- Participation in "RelStat 21'' Programme Committee - Collaboration Agreement in scientific and academic activities (Design of Doctoral program, researcher mobility, etc.)
Maritime Academy	- Collaboration Agreement in scientific and academic activities (Design of Doctoral program, researcher mobility, etc.)
BA School of Business and Finance	- Participation in "RelStat 21'' Programme Committee
Riga International School of Economics and Business Administration	- Participation in "RelStat 21'' Programme Committee
Latvian Agriculture University	- Collaboration Agreement in scientific and academic activities (Design of Doctoral program, researcher mobility, etc.)
"Accenture Latvia"	- Joint "Java" vocal training development - TSI "Career day" participation - Open lectures at TSI - Joint scientific seminars - Joint event management (e.g., "Action Days") - Student study visits to Accenture office
Local Enterprises	**Type of collaboration / B2B projects**
"X INFOTECH" Ltd	- Strategic partnership - Joint scientific work competition for TSI Students - Development of joint Laboratory IPB & ABC in TSI - Collaborative internship program - TSI "Career Day" participation - Scholarships grants for TSI Students

	- Open lectures at TSI (IT, ICT topics) and student study visits to X Infotech office
C.T.Co	- Joint event management (guest lectures)
Deloitte Latvia	- Joint event management (Science-to-Business seminar)
RoboLogic	- Collaborative applied research
French Institute	- Research seminar
SIA "HBT"	- Cooperation agreement in frame of Investment and Development Agency of Latvia voucher programme
SIA "White Cardinals International"	- Cooperation agreement in frame of Investment and Development Agency of Latvia voucher programme
SIA "ARGENTO LAB"	- Cooperation agreement in frame of Investment and Development Agency of Latvia voucher programme

5.1. National Collaboration

The table below indicates the most significant activities in collaborations and cooperation with research and academic organizations, enterprises and companies, both at local and international levels. In compare with 2020 annual period, there were more collaborative activities with enterprises, as well as growth in numbers of joint projects and collaboration with research/academic organizations.

Scope of national and international collaboration

5.2. Scope of National Level Collaboration Projects

Table 8

Scope of National Level Collaboration Projects

Project	Type
Model of Smart Economy in a Smart City	National / Postdoc Latvia
Slot sistēmas izstrāde multikompleksai IHC histoloģiskajai krāsošanai (Development of the Slot system for multiplex IHC histological staining) SIA Argento Lab	Consulting project
FARO Lāzera Skenera Ārējās Panorāmas Kameras Izstrāde (Development of FARO Laser Scanner External Panoramic Camera) SIA "WHITE CARDINALS International"	Consulting project
3D punktu mākoņu algoritma izstrādes izpēte (Research Project on 3D point cloud algorithm development) SIA "My3D.Cloud"	Consulting project

5.3. International Level Collaboration Projects

Table 9

Scope of international collaboration in projects

ERASMUS+ KA2	
TYPE OF COLLABORATION	FIELD OF SCIENCE
Ecosystem for European Education Mobility as a Service: Model with Portal Demo (eMEDIATOR)	Research / education
INGENIOUS-strengthenINg diGital pEdagogy skills aNd competencIes Of edUcatorS	Research / education
Digitally supported and virtual study practices for modern logistic systems. "DIGILOG"	Research / education
HORIZON 2020	
TYPE OF COLLABORATION	
Enhanced Physical Internet-Compatible Earth-friendly freight Transportation ansWer (ePIcenter)	Research / education
Fundamentals of Design Competence for Our Digital Future (D-CoDE)	Research / education
Workforce Europe – Transformation agenda for transport automation (We-Transform)	Research / education
INTERREG	
TYPE OF COLLABORATION	FIELD OF SCIENCE
Smart Logistics and Freight Villages Initiative (SmartLog)	Research
Intelligent Transport and Transport Management study module (INTELTRANS)	Research
COST	
TYPE OF COLLABORATION	FIELD OF SCIENCE
Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport	Research / ICT
Project 19102 Language In The Human-Machine Era	Research / NLP
Project 18236 Multi-disciplinary innovation for social change (SHIINE)	Social sciences
ESF/ERDF	
TYPE OF COLLABORATION	FIELD OF SCIENCE
Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialization (STTIAS)	Research / education
Project “Innovation Grants for Students at the Institute of Transport and Communications” / iDEAHUB	Research / education

5.4. Most Important Foreign Collaborators

Table 10

Scope of important foreign collaboration

ORGANIZATION	TYPE OF COLLABORATION	COUNTRY
Academic organizations	**Cooperation**	
University of Deusto	- Scientific and academic activities (visits)	Spain
University of Ioannina	- Common participation in ERASMUS+ project (eMEDIATOR)	Greece
University of Lodz	- Common participation in ERASMUS+ project (eMEDIATOR)	Poland
Panepistimio Ioanninon University	- Common participation in ERASMUS+ project (INGENIOUS)	Greece
Technische Universiteit DELFT (TU Delft)	- Common participation in H2020 project (D-CoDE)	Netherlands
UMEA Universiteit (UMU)	- Common participation in H2020 project (D-CoDE)	Sweden
The University of Ed Edinburgh (UEDIN)	- Common participation in H2020 project (D-CoDE)	United Kingdom
Kobenhavns Universitet (UCPH)	- Common participation in H2020 project (D-CoDE)	Denmark
Aarhus Universitet (AU)	- Common participation in H2020 project (D-CoDE)	Denmark
Stichting Hogeschool Van Amsterdam (HVA)	- Common participation in H2020 project (D-CoDE)	Netherlands
Politecnico Di Torino (POLITO)	- Common participation in H2020 project (WE-TRANSFORM)	Italy
University of Surrey (SURREY)	- Common participation in H2020 project (WE-TRANSFORM)	United Kingdom
Institut Vedecom (VEDECOM)	- Common participation in H2020 project (WE-TRANSFORM)	France
Tokai National Higher Education and research System, National University Corporation (Nagoya Univ)	- Common participation in H2020 project (WE-TRANSFORM)	Japan
Board of Regents of Nevada System of Higher Education (UNLV)	- Common participation in H2020 project (WE-TRANSFORM)	United States
Kyungil University (KIU)	- Common participation in H2020 project (WE-TRANSFORM)	South Korea

Ecole Nationale Superieure des Mines de Paris, ENSMP	- Scientific and academic activities (visits)	France
Grenoble Alpes University	- Scientific and academic activities (visits)	France
Technical University of Munich Department of Civil, Geo and Environmental Engineering	- Scientific and academic activities (visits)	Germany
Transport Policy at Delft University of Technology	- Scientific and academic activities (visits)	Netherlands
Inha University in Tashkent	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation	Tashkent
Norwegian University of Science and Technology	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation	Norway
European Humanities University	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation	Lithuania
Exupery International School (EIS)	- Cooperation agreement in IT, telecommunication, robotics and aviation	Latvia
Arab Academy of Science, Technology and Maritime Transport	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation	Egypt
Academic organizations	**Cooperation**	
Telecommunication Institute of Aveiro	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute Academic Staff in the Areas of Strategic Specialisation	Portugal
De Montfort University	- Collaboration in scientific and academic activities in European Social Fund project "Strengthening Transport and Telecommunication Institute	United Kingdom

	Academic Staff in the Areas of Strategic Specialisation	
Tallinn University of Technology (TUT)	- Collaboration Agreement in scientific and academic activities - Joint Project collaboration (EDU-RAIL, SmartLog)	Estonia
University of Zilina	- Researcher and academic mobility	Slovakia
The University of Thessaly, Greece	- Collaboration Agreement in scientific and academic activities (Design of Doctoral program, researchers' mobility in EU Project Horison-2020, etc.) - Joint participation in H2020 Project Alliance - Double supervision for PhD student approbation - Joint Summer School in Riga for PhD and MS students - Finalizing Alliance Conference - Transport and Telecommunication Journal Board membership, reviewing	Greece
Regional Open Social Science University, Yoshkar-Ola	Organizing committee of the International scientific-practical conference	Russia
VSEI of Lublin	Researcher and academic mobility	Poland
University of the West of England ("UWE")	Academic cooperation and exchanges and the development of double degree programmes across a range of academic areas including Computer Science and Aviation.	United Kingdom
Vilnius Gediminas Technical University (VGTU)	Conference/Workshop Mutual Participation	Lithuania
Satakunta University of Applied Sciences (SAMK)	Cooperation agreement in the framework of the Erasmus+ programme	Finland
University POLITEHNICA of Bucharest	Knowledge Alliance in Air Transport Project	Romania
Margad University of Mongolia	Researcher and academic mobility	Mongolia
Instytut Morski W Gdansku (MI)	Common participation in H2020 project (ePicenter)	Poland
Hochschule Emdeni/Leer (HS EL)	Common participation in H2020 project (ePicenter)	Germany
Shandong University (SDU)	Common participation in H2020 project (ePicenter)	China
University Laval (U LAVAL)	Common participation in H2020 project (ePicenter)	Canada
Universidad De La Sabana (UNISABANA)	Common participation in H2020 project (ePicenter)	Colombia

Heriot-Watt University (HWU)	Common participation in H2020 project (ePicenter)	United Kingdom
Academic organizations	**Cooperation**	
Samara State Technical University, Samara	Organizing committee of the International scientific-practical conference	Russia
Kyiv National Economic University named after Vadym Hetman; department of Strategic Management	Organizing committee of the International scientific practical conference	Ukraine
Research Institutes	**Cooperation**	
Fraunhofer-gesellschaft zur foerderung der angewandten forschung e.v.	- Collaboration in scientific and academic activities (Design of Doctoral program, researchers' mobility in EU Project Horizon2020, - Common participation in H2020 Project ("Alliance") - PhD workshop in Magdeburg, participation of students	Germany
Bulgarian Association for Management Development and Entrepreneurship	Research mobility	Bulgaria
BIBA – Bremer Institut Fuer Produktion und Logistik GMBH (BIBA)	Common participation in H2020 project (ePicenter)	Germany
Enterprises	**Cooperation**	
Cleantech Bulgaria Ltd.	Common participation in ERASMUS+ project (INGENIOUS)	Bulgaria
Confederation of the employers and industrialists in Bulgaria KRIB	Common participation in ERASMUS+ project (INGENIOUS)	Bulgaria
Styrian Technology Park	Common participation in ERASMUS+ project (INGENIOUS)	Bulgaria
Diavalkaniko Kentro Epicheirimatikis Anaptyxis AE	Common participation in ERASMUS+ project (INGENIOUS)	Greece
Sistemi Formativi Confindustria SCPA	Common participation in ERASMUS+ project (INGENIOUS)	Italy
PHILIPS Electronics Nederland BV (PHILIPS)	Common participation in H2020 project (D-CoDE)	Netherlands
Training Center "Aviator"	Collaborative project	Russia
Havenbedrijf Antwerpen (PoA)	Common participation in H2020 project (ePicenter)	Belgium

DHL Management (Switzerland) Ltd (DHL)	Common participation in H2020 project (ePicenter)	Switzerland
Panasonic Business Support Europe GMBH (Panasonic)	Common participation in H2020 project (ePicenter)	Germany
Continental Dack Sverige AB (Continental)	Common participation in H2020 project (ePicenter)	Sweden
Stena Rederi AB (Stena Rederi AB)	Common participation in H2020 project (ePicenter)	Sweden
Autoridad Portuaria De La Bahia De Algeciras Mopt (APBA)	Common participation in H2020 project (ePicenter)	Spain
Total Terminal International Algeciras SA (TTI ALGECIRAS)	Common participation in H2020 project (ePicenter)	Spain
Logistic-Initiative Hamburg Management GMBH (LIH)	Common participation in H2020 project (ePicenter)	Germany
Duisburger Hafen Aktiengesellschaft (DUISPORT)	Common participation in H2020 project (ePicenter)	Germany
Anheuser Busch Inbev (AB INBEV)	Common participation in H2020 project (ePicenter)	Belgium
Aker Arctic Technology OY (AKER)	Common participation in H2020 project (ePicenter)	Finland
MJC2 Limited (MJC2)	Common participation in H2020 project (ePicenter)	United Kingdom
GVZ Entwicklungs gesellschaft Wolfsburg MBH (GVZe)	Common participation in H2020 project (ePicenter)	Germany
Einride AB (Einride)	Common participation in H2020 project (ePicenter)	Sweden
TIS PT, Consultores EM Transportes, Inovacao E Sistemas SA (TISPT)	Common participation in H2020 project (ePicenter)	Portugal
Effective Seaborne Engineering Solutions SL (ESES)	Common participation in H2020 project (ePicenter)	Spain
NXPORT (NxPort)	Common participation in H2020 project (ePicenter)	Belgium
Balance Technology Consulting GMBH (BAL)	Common participation in H2020 project (ePicenter)	Germany

Den Hartogh Holding B.V (Den Hartogh)	Common participation in H2020 project (ePicenter)	Netherlands
Logit One NV (Logit One)	Common participation in H2020 project (ePicenter)	Belgium
Polskie Koleje Panstwowe Spolka Akcyjna (PKP S.A.)	Common participation in H2020 project (ePicenter)	Poland
Uprava Pomorske Sigurnosti I Upravljanja Lukama (MSP)	Common participation in H2020 project (ePicenter)	Montenegro
Beijing Trans Eurasia International Logistics LTD (BTE)	Common participation in H2020 project (ePicenter)	China
Union Internationale Des Chemins De Fer (UIC)	Common participation in H2020 project (WE-TRANSFORM)	France
MERCEDES-BENZ AG (MERCEDES-BENZ)	Common participation in H2020 project (WE-TRANSFORM)	Germany
Hitachi Rail STS (STS)	Common participation in H2020 project (WE-TRANSFORM)	Italy
POLIS – Promotion of Operational Links With Integrated Services, Association International (POLIS)	Common participation in H2020 project (WE-TRANSFORM)	Belgium
Ferrovie Dello Stato Italiane SPA (FS SPA)	Common participation in H2020 project (WE-TRANSFORM)	Italy
European Road Transport Telematic Simple Mention Coordination Organization – Intelligent Transport Systems & Service Europe (ERTICO ITS EUR)	Common participation in H2020 project (WE-TRANSFORM)	Belgium
Fundacion De La Comunidad Valenciana Para La Investigacion, Promocion y Estudions Comerciales De Valencia Port (VPF)	Common participation in H2020 project (WE-TRANSFORM)	Spain
Austriatech – Gesellschaft Des Bundes Fur	Common participation in H2020 project (WE-TRANSFORM)	Austria

Technologie Politische Massnahmen GMBH (AUSTRIATECH)		
Leonardo - Societa Per Azioni (LEONARDO)	Common participation in H2020 project (WE-TRANSFORM)	Italy
Trainose Metafores – Metaforikes Ypiresies Epivaton Kai Fortiou AE (TRAINOSE)	Common participation in H2020 project (WE-TRANSFORM)	Greece
Fdedrazione Italiana Lavoratori Transporti (CGIL)	Common participation in H2020 project (WE-TRANSFORM)	Italy
Uiltrasporti (UILTRASPORTI)	Common participation in H2020 project (WE-TRANSFORM)	Italy
Empresa Municipal De Transportes De Valencia SA (EMT VALENCIA SA)	Common participation in H2020 project (WE-TRANSFORM)	Spain
Attiko Metro AE	Common participation in H2020 project (WE-TRANSFORM)	Greece
Fundacja Rozwoju Logistyki I Zarzadzania (CILT(UK)-Polska)	Common participation in H2020 project (WE-TRANSFORM)	Poland
LGI Consulting (LGI)	Common participation in H2020 project (WE-TRANSFORM)	France
Tampereen Kaupunkiseudun Elinkeinoja Kehitysyhtio Business Tampere OY (BT)	Common participation in H2020 project (WE-TRANSFORM)	Finland
Idryma Evgenidou (EF)	Common participation in H2020 project (WE-TRANSFORM)	Greece
Virtech OOD (VIRTECH OOD)	Common participation in H2020 project (WE-TRANSFORM)	Bulgaria
Panepistimio Aigaiou (UAegean)	Common participation in H2020 project (WE-TRANSFORM)	Greece
Panepistimio Dytikis Attikis (UWA)	Common participation in H2020 project (WE-TRANSFORM)	Greece
Missions Publiques (MP)	Common participation in H2020 project (WE-TRANSFORM)	France
Traviglia Notaro Vernetti-Associazione Professionale (TNV)	Common participation in H2020 project (WE-TRANSFORM)	Italy
KEOLIS (KEOLIS)	Common participation in H2020 project (WE-TRANSFORM)	France

5.5. Important Scientific Cooperation Events

Course "Decision making methodologies" for master and PhD students by Eftihia Nathanail from University of Thessaly (Greece)

From 19 February till 23 April 2021 Professor Eftihia Nathanail from University of Thessaly, (Greece) conducted a course "Decision making methodologies" for master and PHD students in Transport and Telecommunication institute (TSI).

Course topics:

- An Introduction to decision - making background, techniques, concerns
- Cost benefit analysis
- Evaluation methods
- Monetary-based techniques (cost-effectiveness and cost-benefit analyses)
- Multi-attribute Utility Theory (MAUT)
- Multi criteria decision analysis (Delphi, Analytical Hierarchy Process, normalization)
- Decision making in transportation systems (transportation and logistics projects – EVALOG)
- Outranking methods (Electre, Promethee)
- Multi objective mathematical programming (optimisation using Solver and Sitation)
- Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
- Monte Carlo Analysis
- Fuzzy Logic Method

5.6. Non-academic collaborations

Table 11

Non-academic collaboration

Name and Organisation	Type of collaboration	Country
Latvian Electrical Engineering and Electronics Industry Association (LETERA)	Membership, joint research	Latvia
International Airport “Riga”	Professional Master's in Aviation Management	Latvia
Latvian Information and Communications Technology Association (LIKTA)	Membership, joint research	Latvia
BITS (Baltic Information Technology Society)	Membership, joint promotion of research in STEM	Latvia
Informatics Europe	Membership, information exchange	Switzerland
European Conference of Transport Research Institutes (ECTRI)	Membership, information exchange, reviewing	EU
RAF-AVIA	Professional Master's in Aviation Management	Latvia
Association Latvijas Auto	Consultation	Latvia
Latvian Association of Remotely Piloted Aircraft Systems	Membership, Co-founder, Consultation, Projects.	Latvia

Latvian Aviation Association	Membership	Latvia
Scientific Training Consultation Center of Transport and Logistics (ZMKTLC)	Consultation	Latvia
Association of Paneuropa Coach Terminals	Member of Expert Board	Germany
Ltd. LEO Research Centre	Membership invited lectures, joint projects	Latvia
Ltd. “WING 4 SKY GROUP”	Professional Master's in Aviation Management	Latvia
ECTRI	Irina Jackiva is a Vice President of the association	Belgium
Ltd. “Airline Support Baltic”	Professional Master's in Aviation Management	Latvia

6. MEMBERSHIP IN EDITORIAL BOARDS (JOURNALS, CONFERENCES, ASSOCIATIONS)

TSI research and academic staff continue actively participation in the various scientific committees of conferences, as well as in editorial boards of scientific journals, which is very important for continuously growth of expertise area and advanced knowledge sharing.

Table 12

Memberships in Boards (Journals, Conferences, Associations)

Name	Journal
Igor Kabashkin	- Computer Modelling and New Technologies (ISSN 1407-5806), Latvia - Transport and Telecommunication (ISSN 1407-6160), Latvia - Journal of Air Transportation (ISSN 1093- 8826), USA, University of Nebraska at Omaha - Transport (ISSN 1392-1533), Lithuania, Lithuanian Academy of Science - Technological and Economic Development (ISSN 1392- 8619), Lithuania, Vilnius Gediminas Technical University - Aviation" (ISSN 1392-1534), Lithuania, Vilnius Gediminas Technical University - Journal "Transactions on Transport Sciences" (ISSN 1802-971X), Czech Republic, Ministry of Transport - Sustainable Spatial Development" (ISSN 1691-6174), Riga Technical University - Journal of Aviation Technology and Engineering" (ISSN 2159-6670), published by Purdue University Press, USA - Baltic Journal of Modern Computing (ISSN 2255-8950 electronic; ISSN 2255-8942 paperback), Estonia-Latvia-Lithuania
Irina Yatskiv	- Transport and Telecommunication (ISSN 1407-6160), Latvia - Mathematics in Engineering, Science and Aerospace (ISSN 2041-3165) - Maintenance and Reliability, Polish Maintenance Society (Warsaw) - Transport (ISSN 1392-1533), Lithuania, Lithuanian Academy of Science - Economics of Development, Kharkov National University of Economics - Sustainable Development of Transport and Logistics, Open Access Journal. ISSN 2520-2979
Alexander Grakovski	- Transport and Telecommunication (ISSN 1407-6160), Latvia
Julia Stukalina	- Business, Management and Economics Engineering (Lithuania) https://journals.vgtu.lt/index.php/BME/aimsandscope - Green, Blue and Digital Economy Journal http://baltijapublishing.lv/index.php/gbdej - Journal of Marketing for Higher Education - Taylor & Francis - Higher Education Pedagogies - Taylor & Francis - International Journal of Educational Management - Emerald - Higher Education Quaterly - Wiley-Blackwell
Jurijs Tolujevs	- Transport and Telecommunication (ISSN 1407-6160), Latvia
Alexander Andronov	- Automatic Control and Computer Sciences (ISSN 0146-4116), Latvia

Aleksander Stetjuha	- Economic Alternatives", ISSN 1312-7462 University of National and World Economy, Sofia, Bulgaria http://www.unwe.bg/eajournal/en
Irina Kuzmina-Merlino	- International Management Journals, United Kingdom, London. ISSN: 1742-528X (on-line Journals), IMJ Editorial Advisory Board http://www.managementjournals.com/editorialteam.htm - The Clute Institute, Journal of Business Case Studies, ISSN 1555-3353 (print); ISSN 2157-8826 (online) Reviewers' team http://journals.cluteonline.com/index.php/JBCS/about/displayMembership/39 - Emerald Emerging Markets Case Studies Journal, Reviewer http://www.emeraldgrouppublishing.com/reviewers/index.htm - The University of World Economy, Editorial Board of University Yearbook (research papers), ISSN: 1312-5486 (print); ISSN (on-line) 2534-8949 http://yearbook.unwe.bg - Journal "Forum Scientiae Oeconomia", Warsaw, Poland (ISSN 2300-5947 - printed, ISSN 2353-4435 - online), reviewer http://www.wsb.edu.pl/reviewers,m,f,2039
Aleksandr Medvedev	- Journal of Traffic and Transportation Engineering. David Publishing Company. New York, USA – editorial board member - Interstate aviation committee member of Coordinating Council
Georgs Utehins	- Lublin Higher School of Economics and Innovation (WSEI) – editorial board member
Kristine Užule	- Scientific Journal of the Siberian Federal University (Russia) "Gumanitarnije nauki", ISSN 2587-6066, http://journal.sfu-kras.ru/series/humanities/editorial-board
Jeļena Popova	- Green, Blue and Digital Economy– member of Editorial Board (http://baltijapublishing.lv/index.php/gbdej/editorial) - Transport Development – member of Editorial Board (https://journals.onmu.in.ua/index.php/journal/about/editorialTeam) - Cultural Heritage & Tourist Destinations – Editor (ISSN 2592-8449, https://bsa.edu.lv/wp-content/docs/science/book/touristjournal1.pdf) - Development of Modern Business within the Concept of Green Economy - member of editorial and scientific committee (https://bsa.edu.lv/wp-content/docs/science/book/Concept_Green_Economy_3.pdf) - International Scientific and Practical Conference Cultural Heritage & Tourist Destinations: Creative Approaches in Development, Riga, Latvia - International scientific conference Development of Modern Economic Science in the Context of Digitalization, Riga, Latvia - Journal of Tourism and Services
Boriss Misnevs	- International Journal on New Trends in Education and Their Implications (IJONTE), Editorial Board Member – ISNN: 1309 – 6249. http://www.ijonte.org/?pnum=11&pt=Editorial+Board - International Women Online Journal on Distance Education - WOJDE, ISSN: 2147-0367) - http://www.wojde.org/?pnum=5&pt=Editorial%20Board - "Informatics Europe" association, TSI representative member

6.1. Memberships in Program and Organization Committee of Scientific Conferences

Table 13

TSI staff memberships in Programme and Organization Committees of scientific conferences

Name	Memberships
Igor Kabashkin	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - Programme Committee of the International Conference "European-Asian Transport Corridors: Trends. Strategies. Practices" - Transport Means 2018 - Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia - Programme Committee of the Conference "Actual Problems of Education", Riga, Latvia
Irina Yatskiv	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - Programme Committee of the International Conference on Dependability and Complex Systems (DepCoS-RELCOMEX), Wroslaw, Poland - Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia. - Programme Committee of the Conference "Actual Problems of Education", Riga, Latvia
Alexander Grakovski	- Programme Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia. - Member of Programme Committee of the International Conference on Dependability of Computer Systems DepCoS–RELCOMEX (Wroclaw, Poland) - International expert of independent agency for accreditation and rating IAAR (Nur-Sultan, Kazakhstan)
Jurijs Tolujevs	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia. - Membership in the Program Committee. International Winter Simulation Conference (USA, December 13-15, 2021).
Boriss Misnevs	- The 21st International Multidisciplinary Conference on Reliability and Statistics in Transportation and Communication, RelStat2021, Members of the Program Committee; - "Research and Technology – step to the future, RetSif'21, Riga, Latvia. Member of Program and Organization Committee of the Conference.

Irina Kuzmina-Merlino	- International Multidisciplinary Conference "Reliability and Statistics in Transportation and Communication" (RelStat), annually. https://tsi.lv/research/activities/scientific-events-conferences/ - The Clute Institute, Journal of Business Case Studies, ISSN 1555-3353 (print); ISSN 2157-8826 (online) Editorial Board. http://clutejournals.com/index.php/JBCS/about/editorialTeam - The University of World Economy, Editorial Board of University Yearbook (research papers), ISSN: 1312-5486 (print); ISSN (on-line) 2534-8949 http://yearbook.unwe.bg - Kyiv National Economic University named after Vadym Hetman, KNEU. Management: strategic imperatives and trends of transformations: monograph. ISBN 978–966–926–342–1. Editorial Board. - Emerald's Emerging Markets Case Studies (EMCS). http://www.emeraldgrouppublishing.com/products/case_studies/eab.htm - Financial Innovation. Springer Open. https://jfin-swufe.springeropen.com/ - The Central European Business Review Journal (CEBR); ISSN 1805-4862 (Online), Link on Reviewer: https://cebr.vse.cz/reviewer.php?identification=60420507219cb&request=status - International Strategic Management Conference (annually from 2015), Peer-Review Committee; European Proceedings of Social and Behavioural Sciences is published by Future Academy, http://www.isma.info/ismc2019/?p=peer-review-committee - Universal Journal of Accounting and Finance. Horizon Research Publishing Corporation, https://www.hrpub.org/journals/jour_reviewers.php?id=22
Aleksandr Medvedev	- Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia. - Inter- higher school scientific and educational conference "Actual problems of education" (TTI) – programme committee member
Georgs Utehins	- Lublin Higher School of Economics and Innovation (WSEI) – editorial board member, "Transportation systems and Information Technology"
Mihails Savrasovs	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - Scientific Committee of the International Conference on Sustainable Urban Mobility, Volos, Greece
Dmitry Pavlyuk	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia. - Co-chair of the Sixth Workshop on Computer Modelling in Decision Making (CMDM 2021), Saratov, Russia, November 2021. http://risk2021.sgu.ru/workshop.php?lang=en - Guest co-editor of Information journal, special issue Soft Computing in Intelligent Transportation System

	https://www.mdpi.com/journal/information/special_issues/Computing_Transportation (with E.Onieva, Deusto) - Member of Traffic Management & Modelling, ECTRI TG
Ishgaley Ishmuhametov	- Member of the Programme Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia
Anna Palma	- Heritage & Tourist Destinations: Creative Approaches in Development - The International Scientific Conference Tourism and Innovations, University of Economics, Varna, Bulgaria. Peer reviewer
Jeļena Popova	- International Scientific and Practical Conference Cultural Heritage & Tourist Destinations: Creative Approaches in Development - The International Scientific Conference Tourism and Innovations, University of Economics, Varna, Bulgaria. Peer reviewer
Aleksandrs Stetjuha	- Member of the International Advisory Board of the Journal "Economic Alternatives", University of National and World Economy, Sofia, ISSN 1312-7462
Julia Stukalina	- Member of the Programme Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia - 7th International Scientific Symposium "Economics, Business & Finance", Jurmala, Latvia - Scientific Committee member - 16th International Strategic Management Conference, Baku, Azerbaijan State University of Economics -Session chair "Economics and Financial Management"
Irina Pticina	- Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia.
Ilze Sproģe	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia.
Inna Stecenko	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia. - Programme and Organization Committee of the Conference "Research and Technology – step to the future, Riga, Latvia.
Nadežda Spiridovska	- Programme and Organization Committee of the International Conference "Reliability and Statistics in Transport and Communication", (RelStat), Riga, Latvia.

6.2. Memberships in committees and in scientific advisory boards of business companies or other similar tasks of no primarily academic nature

One of the most important outcomes and goals for TSI Research & Development program is support and knowledge sharing for business. R2B connections and communications is supported by participation of TSI Research/Academic Staff in business company's scientific advisory boards.

Table 14

TSI Staff membership in scientific advisory boards of business companies and associations

Name	Tasks
Igor Kabashkin	Scientific supervisor of Latvian Centre of Competence in Transport, Energy and Manufacturing
Irina Yatskiv	External expert in Association of Paneuropian Coach Terminals Member of Board, ECTRI
Alexander Grakovski	Member of Council of expert working group of the electronic communications sector (Latvian Ministry of Transport)
Aleksandr Medvedev	Telemātikas un loģistikas institūts Ltd. – board member Aviation Research Center Ltd. – board member Member of Latvian professorial association of higher schools
Ieva Kozlovska	Member of examination commission of the Latvian Association of Sworn Auditors

6. SUBMITTED PROJECT APPLICATIONS

Table 15

Submitted Project Applications (2021)

No	Application	Type of project/programme
1	Ecosystem for European Education Mobility as a Service: Model with Portal Demo (eMEDIATOR)	ERASMUS+
2	INGENIOUS-strengthenINg diGital pEdagogy skills aNd competencIes Of edUcatorS	ERASMUS+
3	Development of the Slot system for multiplex IHC histological staining (Tones)	Voucher programme (LIAA)
4	3D point cloud algorithm development (Bubbles)	Voucher programme (LIAA)
5	Automated creation of 3D data download, registration and purification system	Norway Financial Instrument
6	Project “Innovation Grants for Students at the Institute of Transport and Communications” / iDEAHUB (Nr.1.1.1.3/21/A/006)	ERDF
7	Public Transportation Electrification considering spatial-temporal renewable energy supply-demand balancing	Baltic-Nordic Energy Research Program for 2022-2023

7. FINANCING OF RESEARCH

Table 16

2021 TSI R&D Budget

Financing	Amount EUR without VAT (21%)
Financing for the research	**843 993**
National budget financing	136 191
Revenues from contract work with another Latvian legal entities	15 903
Foreign financing (financing received from international organizations or international organizations contract basis, payments received from abroad on research activities)	637 389
Other funding for scientific work together: References from conferences, seminars, etc.	54 509

ANNEX 1

1. Lists of most important publications by academic personnel and researchers with doctoral degree

1. **Y. Popova** and **I. Sproģe**. "Decision-Making within Smart City: Waste Sorting", *sustainability*, Vol. 13. 2021, pp. 10586.
2. **B. Misnevs**, A. Puptsau and V. Jusas. "Methodology for Constructing and Using a Mathematical Model for Assessing Labor Costs for the Development of Distance Learning Courses", *Mathematics*, Vol. 9, 3049. 2021, pp. 1-12.
3. **Y. Stukalina** and **D. Pavlyuk**. "Using customer-based brand equity model in the higher education context: Simulating the current university's brand", *Journal Business, Management and Economics Engineering*, Vol. 19, Oct. 2021, pp. 272-288.
4. **D. Pavlyuk**. "Spatiotemporal cross-validation of urban traffic forecasting models", *Transportation Research Procedia*, Vol. 52. 2021, pp. 179-186.
5. **I. Kabashkin**. "Fault tolerance of cluster-based nodes in IoT sensor networks with periodic mode of operation" In book: "Security and Privacy Issues in IoT Devices and Sensor Networks. Advances in ubiquitous sensing applications for healthcare". Academic Press, Elsevier. 2021. pp. 133-152.
6. H. Kitzmann, **I. Kabashkin**, M. Rössle and N. Dolle. "Supply Chain Management and Logistic Development in International Context: Challenge for Cross-National Education." In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. pp. 814-822.
7. **A. Krivchenkov**, **B. Misnevs** and **A. Grakovski**. "Experimental Comparison of ML/DL Approaches for Cyberattacks Diagnostics" In book: "Advances in Intelligent Systems and Computing. Proceedings of the Sixteenth International Conference on Dependability of Computer Systems DepCoS-RELCOMEX, June 28 – July 2, 2021, Wrocław, Poland". W. Zamojski, J. Mazurkiewicz, J. Sugier, T. Walkowiak and J. Kacprzyk eds. Springer Nature. 2021. pp. 213-223.
8. **I. Ishmuhametov** and **L. Kuzmenko**. "The Study of Students' Opinion on Learning Online in the Self-Isolation Period" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 857-867.
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11. **I. Kabashkin**, **A. Grakovski** and W. Segercrantz. "DIGILOG Project: Digitally Supported and Virtual Study Practices for Modern Logistic Systems" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 771-781.
12. **K. Užule**, **I. Kuzmina-Merlino** and M. Merlino. "Modern Managers in Gig Economies: Competencies, Personality and their Effect on Manager Education in the Digital Era" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 613-622.
13. **A. Grakovski** and **A. Krivchenkov**. "Evaluation of the Efficiency of Energy Storage Systems (ESS) in the Problem of Reducing the Energy Consumption Costs in Long-Term Planning" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in

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14. P. Skačkauskas and **A. Grakovski**. "Efficiency Analysis of Stanley's Controller Applied to the Autonomous Ground Vehicle Movement Control Under Effect of Various Perturbations" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 420-430.
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23. **N. Spiridovska** and **I. Jackson**. "Simulation Experiments on Markov-Modulated Linear Regression Model" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 21-31.
24. **A. Krivchenkov**, **B. Misnevs** and **A. Grakovski**. "Using Machine Learning for DoS Attacks Diagnostics" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer. 2021. pp. 45–53.
25. M. Pivovar, **B. Misnevs**, L. Rozhkova and **I. Pticina**. "Data Quality Indicators of ETL in the Process of Implementation of Information Systems for Aircraft Maintenance and Operation" In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. 2021. pp. 130-139.

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34. **Tyncherov, T., Rozkova, L.** Predictive Maintenance Model of Refined Aircraft Tires Replacement (2021) In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham., pp. 164-173.
35. **Endrjukaite**, **T., Dudko, A.** Energy Policy and Economy Based on Energy Trading and Routed Energy Distribution Network (2021) In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham., pp. 450-459.
36. **Smagina, A.,** Ludviga, I. Craft entrepreneurship: Toward a new typology (2021) International Journal of Organizational Diversity, 21 (1), pp. 31-49.
37. Gorbunovs, A., **Lacane, M.A.** Modernization of Landing System Facilities at Riga International Airport (2021) In book: "Reliability and Statistics in Transportation and Communication. RelStat 2020. Lecture Notes in Networks and Systems". I. Kabashkin, I. Yatskiv and O. Prentkovskis eds. Springer, Cham. pp. 194-204.
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applications of unmanned aerial vehicles technology in the resource-rich country (2021) Applied Sciences (Switzerland), 11 (21), art. no. 10171.

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41. Kegenbekov, Z**., Jackson, I.** Adaptive supply chain: Demand-supply synchronization using deep reinforcement learning (2021) Algorithms, 14 (8), art. no. 240,
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2. Other scientific publications

1. **M. Savrasov**, **I. Yatskiv**, **J. Tolujew** and **I. Jackson**. "SIMULATION AS A DECISION SUPPORT TOOL FOR AIRPORT PLANNING: RIGA INTERNATIONAL AIRPORT CASE STUDY", *TRANSPORT*, Vol. 36, June 2021, pp. 474–485.
2. **Y. Popova**. "Economic Basis of Digital Banking Services Produced by FinTech Company in Smart City", *JOURNAL OF TOURISM AND SERVICES*, Vol. 23 (12). 2021, pp. 86-104.
3. **Y. Stukalina**. "Increasing internal and external brand awareness in higher education", *Proceedings of the 13th International Scientific Conference "New Challenges in Economic and Business Development – 2021: Post-Crisis Economy"*. 2021, pp. 433-439.
4. **Y. Stukalina**. "Management of university research: Using international standards of excellence for research evaluation", *Proceedings of the 13th International Scientific Conference "New Challenges in Economic and Business Development – 2021: Post-Crisis Economy"*. 2021, pp. 440-447.
5. J. Alexis Abdor-Sierra, **E. Merchán**, F. Arturo Sánchez-Garfias, R. Gustavo Rodríguez-Cañizo, E. Alfredo Portilla-Flores and V. Vázquez-Castillo. "PARTICLE SWARM OPTIMIZATION FOR INVERSE KINEMATICS SOLUTION AND TRAJECTORY PLANNING OF 7-DOF AND 8-DOF ROBOT MANIPULATORS BASED ON UNIT QUATERNION REPRESENTATION", *Journal of Applied Engineering Science*, Vol. 19. 2021, pp. 592-599.
6. **Y.Stukalina**. "Developing an efficient business strategy in the era of digital transformation". *European Proceedings of Social and Behavioural Sciences EpSBS*. 2021. pp. 54-63.
7. **Y. Stukalina** and A. Roskosa. "Exploring brand personality in higher education". *Proceedings of the International Scientific Conference Rural Environment. Education. Personality (REEP) 2021*. 2021. pp. 176-182.
8. O. Dluhopolskyi, A. Simakhova, T. Zatonatska, S. Kozlovskyi, I. Oleksiv and **J. Baltgailis**. "Potential of Virtual Reality in the Current Digital Society: Economic Perspectives", *IEEE*, 15-17 Sept. 2021, 2021.
9. **V. Siliņeviča**. "Characteristics and trends of indicators of export, import, and electricity consumption in Latvia. Wind power consumption characteristics and trends", The Baltic Journal of Economic Studies, Vol. 7. 2021, pp. 188-195.

a. Textbooks and other research-related publications

b. Conference abstracts

1. **O. Pozdnyakova** and **A. Pozdnyakov**. "Personnel Management: the Problem of Aging in the Academic Environment". *Abstracts of the 21 th International Multi-Conference RELIABILITY and STATISTICS in TRANSPORTATION and COMMUNICATION (RelStat'21), 13–16 October 2021, Riga, Latvia.* I. Kabashkin and I. Yatskiv eds. 2021. pp. 109.
2. D. Kulikov and **I. Ishmuhametov**. "The New Technological Solution in the Organization of Sports Activities of Non-Professional Organizations in the Context of the Green Business: Problems and Perspective". *Abstracts of the 21 th International Multi-Conference RELIABILITY and STATISTICS*

in TRANSPORTATION and COMMUNICATION (RelStat'21), 13–16 October 2021, Riga, Latvia. I. Kabashkin and I. Yatskiv eds. 2021. pp. 107.

3. **B. Misnevs**, **I. Kabashkin** and **K. Užule**. "Ecosystem for Education Mobility as a Service". *Abstracts of the 21 th International Multi-Conference RELIABILITY and STATISTICS in TRANSPORTATION and COMMUNICATION (RelStat'21), 13–16 October 2021, Riga, Latvia.* I. Kabashkin and I. Yatskiv eds. 2021. pp. 104.
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