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March 2021

International Evaluation of Scientific Institutions Activity

Panel Report: Engineering and Technology

Professor Ron Perrott (chair), Professor Esko Kauppinen, Professor Elena Lomonova, Professor Thanasis Triantafillou, Professor Anastasia Zabaniotou, Professor Laurens Katgerman, Professor Martin Berggren, Professor Jozef Novak, Professor Pedro Silva Girão

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Introduction

This International Evaluation of Scientific Institutions' Activity analysed the research performance and international competitiveness, considering also the socioeconomic impact and development potential of the institutions. The results of the evaluation can serve as inputs in policy making and will enable the institutions to improve their performance based on the recommendations.

Due to the number of institutes in the Engineering and Technology category, institutions were evaluated across two sub-panels over two separate weeks.

- **Panel 1** - Profs Perrott (chair), Kauppinen, Lomonova, Triantafillou, Zabaniotou, Katgerman – 12-16/10/2020
- **Panel 2** - Profs Perrott (chair), Kauppinen, Lomonova, Berggren, Novak, Girão – 26-30/10/2020

The panels assessed 16 institutions in total:

E_1 Institute of Physical Energetics
E_2 ISMA University, ISMA Computer Technology Laboratory
E_3 The Research Institute of Latvian Maritime Academy
E_4 Rezekne Academy of Technology Institute of Engineering
E_5 Riga Technical University, Faculty of Civil Engineering
E_6 Transport and telecommunication institute
E_7 Riga Technical University, Faculty of Electronics and Telecommunications
E_8 Ventspils University of Applied Sciences, Engineering and technology research platform
E_9 Riga Technical University Faculty of Materials Science and Applied Chemistry
E_10 Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics
E_11 Riga Technical University, Faculty of Power and Electrical Engineering
E_12 Institute of Electronics and Computer Science
E_13 Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit
E_14 Liepaja University, Engineering and Technologies Unit
E_15 Riga Technical University, Faculty of Computer Science and Information Technology
E_16 University of Latvia, Institute of Mathematics and Computer Science

The Panel evaluated the institutions using the following criteria:

- Quality of the research
- Impact on the scientific discipline
- Economic impact
- Social impact

- Research environment and infrastructure
- Development potential

The evaluation of each institution involved documentary review and Panel Members' online discussions with institutions. The final evaluation of each institute is collective view of the Expert Panel.

The experts were provided with summary data tables for each institution that aggregated data from self-assessment reports in the following manner:

- FTE academic and research personnel 2018 – sum of all academic and research personnel in full-time equivalent in 2018 excluding other acting academic and acting academic research personnel, research attending staff, research technical staff and all level students
- Total number of self-reported outputs 2013-2018 – sum of i) Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS; ii) Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS; iii) Monographs; iv) Patents (Latvia) as well as v) Patents (Europe and international)
- Total funding – sum of i) Total state funding (Base funding plus Competitive state budget funding plus EU Structural Funds plus Other national funding); ii) Total international funding (EU Framework Programmes plus Other international funding); and iii) Private funding.

The analysis of each institution is presented in following sections.

Feedback on Panel assessment received from the institutions is published in the **Error! Reference source not found.**. The Panel has reviewed the feedback and made small changes in some sections.

2 Institution reports

E_1 Institute of Physical Energetics

Institution data

Institute of Physical Energetics	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering, Environmental engineering, Other engineering and technologies
No. FTE academic personnel 2018	-
No. FTE academic research personnel 2018	18.20
Total number of FTE academic and research personnel 2018	18.20
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	154
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	108
Monographs in period 2013-2018	2
Patents Latvian in period 2013-2018	24
Patents (Europe and international) in period 2013-2018	4
Total no. of self-reported outputs in period 2013-2018	292
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	8.46
No. of all outputs in period 2013-2018 per researcher in 2018	16.04
No of PhDs completed 2013-2018	10
No. of PhDs in period 2013-2018 per researcher in 2018	0.55
Total funding 2013 -2018 (Euros)	6,226,757
Total funding in period 2013-2018 per researcher in 2018 (Euros)	342,130

The Institute of Physical Energetics (IPE) is a state scientific institute - a derived public person, founded in 1946. Its main research areas are:

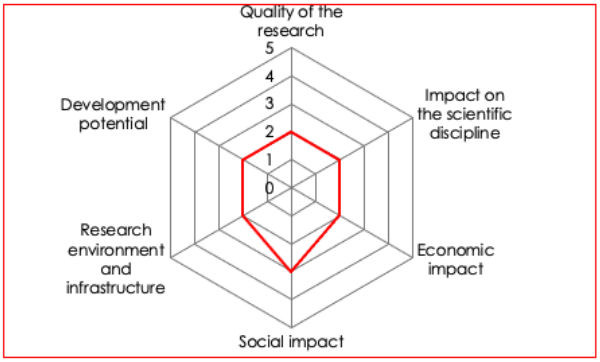
- Energy-environmental technological and economic research
- Smart energy infrastructure research and development planning of smart grids
- Research into rational and efficient use of energy resources
- Research and development of advanced materials and technologies for energy sector

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 1 Institute of Physical Energetics – Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	2
Economic impact	2
Social impact	3
Research environment and infrastructure	2
Development potential	2
OVERALL SCORE	**2**



Overall score

Score: 2 – adequate level of research

The overall score awarded is 2, indicating an adequate level of research. The quality of research and impact on the scientific discipline are adequate, as per international standards. The panel awarded this score considering that there is limited funding, human resources and weaknesses in management of the institution, and thus higher quality research is not achieved. The economic impact is adequate. Social impact and relevance of the research are good, the research infrastructure is reasonable, but the management and leadership need further development.

Quality of Research

Score: 2 - adequate

The institute advertises itself as a medium scale institution, yet in comparison to other institutions in the field it is a small institution, with four main research themes in the area of energy. The focus on these research themes result from a re-organisation of the institute in 2016, at which time there was a substantial reduction in the number of research topics being pursued. The four themes are well chosen and address both technical and economic development aspects of energy research. IPE's research specialization is based on accumulated knowledge and developed competence, and experience in the fields of energy and materials science. The four established research directions are: (I) Energy and environmental technological and economic research; (I) Smart Energy Infrastructure Research and Development Planning of Smart Grids; (iii) Research into the rational and efficient use of energy resources: (iv) Research and development of advanced materials and technologies for the energy sector.

The activities and the vision of the institute are primarily focussed on the development and improvement of the energy requirements and energy efficiency in Latvia and the institute is a satisfactory national player. Although the majority of the research is centred on Latvian requirements, the bulk of the funding comes from outside Latvia. This success of external grant applications is commendable. The Institute is involved in, but does not lead, a number of pan European energy environmental research platforms. The institute does not see itself as a competitor to other energy research institutions in Europe but rather as niche player.

The institute focuses on long-term energy and environment policy development as well as energy security, in particular in relation to integrated energy and climate policy, the impact of using energy and environmental modelling, emission forecasting, analysis of infrastructure development scenarios for alternative transport use, GHG emissions and forecasts for the transport sector. The Institute collaborates with pan-European groups and platforms and is participating in a decarbonisation expert network in 2018 as Latvian experts (EU scenario reference network set up in 2020). Their research output is used by multiple ministries e.g., transport, economy. The institute provides energy modelling of national importance. The IPE has shown a certain 'flexibility' in adapting to changes in funding policy, so a decline in basic funding has been somewhat compensated for by an increase in external funding.

Research output numbers have been consistent over the assessment period, but the publications have been based primarily on studies in the Baltic region. There is some external cooperation among the publications but not a lot. There is good involvement in European projects and networks, but this does not appear to have resulted in, for example, many joint publications. The number of PhD students is small and no Master's students are listed (Master students are supervised through other Institutions). There is a number of national collaborations which have not realised substantial financial benefit to the Institute. There have been a number

of visits abroad but little evidence that such visits resulted in joint publications, research grant applications etc.

The Panel notes that the importance of fundamental research is still recognised by the IPE and industrial partners, but reduction of government funding now threatens the knowledge base and the pool of next generation researchers.

Impact on the scientific discipline
Score: 2 – adequate

The institute's main impact has been within Latvia and it is performing research in both energy efficiency and energy components, which is relevant to the economy and society, in particular the Latvian economy. The institute's activities are well linked into government policies and strategies in the energy sector; this is the main emphasis of the impact sections of the self-assessment document. The publications have been mainly on energy activities and surveys in Latvia and the Baltic region. There is little evidence of publications or research activities influencing research activities outside Latvia. There have been many visits between the institute's staff and other European and international research institutes but the outcome or major impact from any of these visits is not well specified.

The IPE has developed a Smart house Lab, currently moving towards local DC energy systems. Through the Era-Net Cloud Grid project, they are working with Latin American colleagues and the joint research centre in Petten (The Netherlands) and in the Baltic countries (Intelligent Coordination of Operation and Emergency Control of EU and Russian Power Grid (ICOEUR). They use the ARTES and other facilities. Dr. Gaidis Klavs has collaboration with the Berlin Free University, to develop new directions in renewable energy deployment and associated socio-economic aspects to try to attract scientists focusing on these topics.

The IPE has established an international network with a credible scientific approach. During the assessment period, the IPE had several projects within the Eranet, H2020 framework. The IPE works with a number of different research institutes in Norway, Cyprus, Italy, Sweden, and Finland. A joint programme on smart grids has also been established. However, the team has been reduced in size; the staff are looking for external jobs and positions outside the IPE which prevents it from having a greater impact on the scientific discipline.

Economic impact
Score: 2 – adequate

The institute's mission statement is very much focussed on the energy sector in Latvia. The institute has modelled energy development scenarios and assessed the potential for national energy efficiency savings.

The main economic impact is in the area of the supply and use of electric energy. The aim is to improve electrical infrastructure and develop technologies for sustainable, renewable energy systems. The IPE carries out technology and knowledge transfer. IPE researchers provide professional expertise and consultancy services, and cooperate with commercial structures and manufacturing companies, including SMEs, particularly in the areas of the technologies to use the RES potential and energy efficient advanced solutions and implementation tools, smart technology research, equipment development and testing.

Although IPE has provided advice and knowledge transfer to the commercial sector, the detail of how this has led to energy improvements and efficiency within the commercial sector in Latvia is not well demonstrated. The institute has two research divisions which are directly aligned with the RIS3 strategy and is active in five of the RIS3 specialisation areas. There is

commitment to these priorities but lack of evidence on how the institute can make unique contributions to them.

Social impact
Score: 3 - good

The institute's surveys and evaluations influence the Latvian energy sector and Latvian government policy in the energy sector, and this indirectly affects the population of Latvia.

There are two activities of relevance to society. Both aspects are properly and adequately addressed at the national level. The IPE has not received basic funding since 2016 but has obtained significant financing from national authorities on a competitive basis. These projects have higher applied research content and thus provided some economic and social impact.

Good cooperation with municipalities around sustainable energy plans for cities and scenario development is ongoing. The IPE cooperates with Baltic partners e.g., Stockholm Environmental Institute (SEI) in Tallinn, bridging science and policy, as well as with Denmark and Finland, to model Baltic countries' energy consumption from 2030-2050.

Research environment and infrastructure
Score: 2 - adequate

The institute has a wide range of software packages and databases which are fundamental to its research activities, such as model-generating software to help with energy environment systems models in addition to other established software packages for transport, pollution etc.

There is a solar technologies experimental facility linked to a real building for measurements. There is also a testing laboratory and equipment for research on physical characteristics of advanced materials. EU structural funds have made it possible to invest more and develop the state-of-art research infrastructure. There is no indication whether the institute has a renewal plan for its infrastructure over the next years.

Given the relatively small size of the institute with its four main sectors, the management of the research is not too challenging. There were big changes in the number of researchers over the assessment period with a decreasing number in recent years which is a significant concern that is not sufficiently addressed by the leadership. The proportion of support staff is high, which should facilitate research activities.

Development potential
Score: 2 – adequate

The institute's funding in 2018 consisted of national and international research projects: 55% were nationally funded; 28% international projects. Applied projects were 20% of all funding. All financing was from competitive calls. Since 2016 IPE does not receive basic funding and the institute depends only on the competitive funding. The EU structural funds programme made it possible to employ post-doctoral students to do research at the IPE.

The institute does not appear to have the ambition to become a major player in the European or international field, continually describing itself as a medium size entity and content to being a niche player. However, it is providing valuable contributions to Latvian society and industry and is active in areas which are important internationally. It therefore could have potential for further development if appropriate action is taken. The institute has been active in obtaining funding from external sources, in particular from EU programmes. Given that it is not receiving basic funding support since 2016 this is an achievement – the institute is thus acquainted with

the challenges of obtaining funding in a competitive environment. But the staff of the institute has been declining over the years.

The development potential of this institution is very much dependent on external competitive funding schemes and human resources that are limited. Limited management capacity and leadership are also threatening further development. The SWOT analysis contains many relevant comments in all four categories, however, overall, it does not convey a picture of an institute with an international mission statement and international ambitions.

Potential to offer doctoral studies

IPE is not an institution which itself can grant PhD degrees but provides research opportunities for PhD students that are registered at the universities where a doctoral programme is available. IPE staff can and do serve on PhD committees and they are also involved in attracting PhD students for funded research projects, (1-3 persons/per year on the projects alongside their regular research work). An auxiliary and connected issue is that much of the research is performed by researchers with short-term and part-time appointments (PhD-candidates and postdocs), making it difficult to capture the acquired knowledge of their research for the longer term.

Alignment with Smart Specialisation Strategy

The research activity of the IPE is well in line with Latvia's RIS3 specialization areas: Smart energetics and Smart materials, technologies and engineering systems.

Conformity with state scientific and technology development

The research activity of the IPE is strongly in line with the societal demands. IPE regularly cooperates with the energy industry and national leading power supply system companies and thus contributes to energy policy. Though the lack of the proper national basic funding is significantly influencing the scientific output and research strategy of the IPE and its ability to employ new talented researchers.

Recommendations

The strategy, governance and funding of the research activity and facilities at the IPE is unclear. The research strategy is quite broad but covers appropriate objectives. Though the leadership, management and processes of the structures need to be defined better and need to relate to the research directions. This should support implementation of the strategy.

The IPE should implement a plan to ensure the future development and financing of its research and facilities, within the possibilities of the Latvian research and innovation system. This will require continuous effort and leadership from all senior researchers.

The IPE should formulate its main research directions and technological challenges by consolidating the views and roadmaps of its research group(s) and the wider research community.

A comprehensive promotion of the institute's capabilities should be implemented to increase the institute's visibility and attractiveness to other research institutes, universities, industrial companies.

To ensure future development and attracting new (inter)national talent, the IPE should:

(1) offer attractive conditions both in terms of local embedding and remuneration

(2) assist in the transition to Latvia more than at present
(3) exploit their international contacts and resources to enlist excellent new staff members
(4) offer a starting package for leading researchers: for example, by offering funding for 1-2 PhD students and a Post Doc for 4-5 years.

E_2 ISMA University, ISMA Computer Technology Laboratory

Institution data

ISMA University, ISMA Computer Technology Laboratory	
Primary field of science	Engineering and Technology
Corresponding fields of science	Computer and information sciences, Physical sciences, Electrical engineering, electronic engineering, information engineering, Nano-technology
No. FTE academic personnel 2018	0.12
No. FTE academic research personnel 2018	0.12
Total number of FTE academic and research personnel 2018	0.24
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	6
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	-
Monographs	1
Patents Latvian	-
Patents (Europe and international)	-
Total no. of self-reported outputs	7
No. of WoS or Scopus outputs per researcher	25
No. of all outputs per researcher	29.17
No of PhDs completed 2013-2018	-
No. of PhDs per researcher	-
Total funding 2013 -2018 (Euros)	6,436
Total funding per researcher (Euros)	26,817

ISMA Computer Technology Laboratory is a small private institution and its main research directions are:

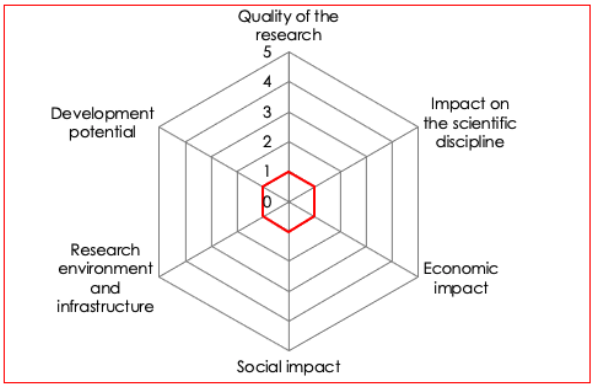
- systematic mathematical and computer modelling in innovative technologies
- scientific prediction and operations research
- research and modelling of nanosciences and nanotechnologies
- design of artificial intelligence devices and development of software based on nanoelements

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 2 ISMA University, ISMA Computer Technology Laboratory– Scores

Criteria	Scores
Quality of the research	1
Impact on the scientific discipline	1
Economic impact	1
Social impact	1
Research environment and infrastructure	1
Development potential	1
OVERALL SCORE	1



Overall score

Score: 1 – poor level of research

ISMA Computer Technology Laboratory is an institution with a subcritical size and a seriously bad funding situation. Consequently, the scientific output is very low, and its impact is negligible both nationally as well as internationally. The panel assesses the probability of successful development in the future as very low unless drastic action is taken. The most promising solution for the Laboratory's problems is to merge it with some larger unit with a better funding and management structure.

Quality of Research

Score: 1 – poor

The institution is very small. It has not specified a budget and there are no personnel reported before 2016. Nevertheless, there is a small output of publications (a total of 16) throughout the evaluation period. Of the 5 publications submitted to the panel to be read 4 contain the same author (Victor Gopeyenko) from the institution, and the 5th does not list any author associated with the institution. It seems like the small amount of research carried out at the institution has been done by teachers in their spare time. The assessment of research in the self-evaluation report is very short, generic, and completely insufficient as input for the panel. Due to its subcritical size and the low output, possibly due to insufficient resources, the panel sees no other option than to evaluate the quality as poor.

Impact on the scientific discipline

Score: 1 – poor

There is possibly some impact through the nano-sensors research, which is however carried out in cooperation with several larger and stronger institutions. Otherwise, the impact is very small due to the low output in internationally recognized venues.

Economic impact

Score: 1 – poor

The self-evaluation report contains no indication of a direct economic impact, for example, any collaboration with industry, or any commercialization of research outputs. The information gathered during the on-line visit unfortunately did not alter this impression.

Social impact

Score: 1 – poor

The self-evaluation report contains no indication of any social relevance except a short generic statement that the field of nanotechnology can possibly have positive consequences in the future, for instance in medicine. The information gathered during the on-line visit unfortunately did not alter this impression.

Research environment and infrastructure

Score: 1 – poor

The completely inadequate self-assessment report makes it difficult to assess the organization, management, and the strategy of the institution. But this deficiency in reporting certainly in itself indicates serious problems with management and planning. The interview that was carried out with the institution further strengthened this impression. The representatives from the institution had a difficult time communicating with the panel, and nobody seemed to know what was written in the self-evaluation report.

The research facilities listed in the self-assessment report are very basic. It is limited to listing access to "all the facilities of ISMA infrastructure including computer laboratory" and five standard desktop computers and a printer.

Development potential

Score: 1 – poor

Based on the above deficiencies regarding the laboratory's subcritical size and funding situation, low output, and a lack of direction and management, the panel has no other choice but to rank the development potential as very low.

Potential to offer doctoral studies

Based on the evaluation above, the institution has at present no potential to offer a doctoral study program.

Alignment with Smart Specialisation Strategy

The very small amount of research carried out in the nanotechnology and biosensor areas certainly aligns with knowledge areas *Biomedicine, medical technologies, bio-pharmacy and biotechnologies*. However, the subcritical size and impact of the work is unsatisfactory.

Conformity with state scientific and technology development

Again, it makes no sense to assess the very small amount of narrow-focused research carried out by the institution towards the grand and general goals of the country.

Recommendations

The grim outlook of the institution makes it necessary to take some dramatic action. The most realistic action is likely to merge with some larger unit with a better management structure. The same recommendation was made in the previous assessment, but unfortunately has not been followed up.

E_3 Research Institute of Latvian Maritime Academy

Institution data

Research Institute of Latvian Maritime Academy	
Primary field of science	Engineering and Technology
Corresponding fields of science	Civil engineering
No. FTE academic personnel 2018	38.55
No. FTE academic research personnel 2018	7.02
Total number of FTE academic and research personnel 2018	45.57
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	32
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	37
Monographs in period 2013-2018	1
Patents Latvian in period 2013-2018	-
Patents (Europe and international) in period 2013-2018	-
Total no. of self-reported outputs in period 2013-2018	70
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	0.7
No. of all outputs in period 2013-2018 per researcher in 2018	1.54
No of PhDs completed 2013-2018	4
No. of PhDs in period 2013-2018 per researcher in 2018	0.09
Total funding 2013 -2018 (Euros)	143,389
Total funding in period 2013-2018 per researcher in 2018 (Euros)	3,147

Latvian Maritime Academy (further LMA) is a state-founded university. The LMA was given the status of a research institution on 06.06.2019. The LMA research areas are:

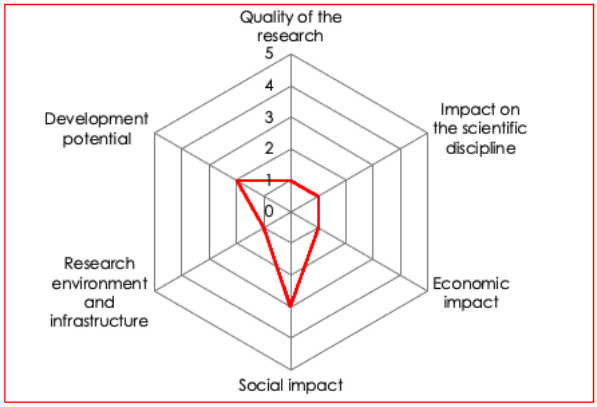
- History of Baltic Shipping
- Maritime Education
- Human Factors in Transport Safety
- Maritime Engineering, incl. Autonomous Ship, Digital Shipping and Cybersecurity and SmartPort.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 3 Research Institute of Latvian Maritime Academy– Scores

Criteria	Scores
Quality of the research	1
Impact on the scientific discipline	1
Economic impact	1
Social impact	3
Research environment and infrastructure	1
Development potential	2
OVERALL SCORE	1



Overall score

Score: 1 – poor level of research

The Research Institute of Latvian Maritime Academy's (LMA) research is weak in the international context. The quality of research is low, the scientific impact is very limited and only

national, and the economic impact is not demonstrated. The social impact has very good potential to become important for the society, but the research activities are characterised by a moderate level of interaction with the public and policy makers. The training component of this interaction is good, hence LMA should carry on its activities with a focus on training and education.

Quality of Research

Score: 1 - poor

Research at the LMA has three main themes: digitalisation of shipping and cyber security, maritime engineering including autonomous shipping, and smart ports. However, research in these areas is not really reflected by publications so far. Researchers of the LMA have published the results of their research mainly in regional journals and conference proceedings. Very few publications are found in good quality international journals. The number of research outputs is very low, both in absolute terms as well as if numbers are normalized per researcher. Numbers of research outputs and citations in Scopus/Web of Science are very low. LMA does not provide doctoral training. The international profile of researchers, as evidenced e.g. by invited lectures, editorial boards, awards etc. is low. Overall, LMA is a national player with limited attempts to develop international collaborations.

Impact on the scientific discipline

Score: 1 - poor

The specific scientific discipline covered by LMA is reasonably well defined. The number of publications in high quality international journals with high impact and citations thereof is very low. Collaboration at the national level is taking place but has limited impact. Efforts with foreign collaborators have been limited, with some signs of potential for increase. Overall, LMA is a national player; it still has to strive for its status as a recognised member of the discipline; its impact on the international scientific community is low.

Economic impact

Score: 1 - poor

Publications with users, particularly the industry, are not in place; no patents are reported, and it seems that research does not sufficiently reach economic players. Collaboration, visits and interaction with the private sector are limited and sporadic. Membership in committees and in scientific advisory boards of non-academic entities is limited. Overall, the research at LMA is important for the economy, but the fruitful interaction with the private sector is yet to be established.

Social impact

Score: 3 - good

Research at LMA has very good potential to become important for the society, but the research activities are characterised by a moderate level of interaction with the public and policy makers. The training component of this interaction is very good, hence LMA should carry on its activities with a focus on training and education.

Research environment and infrastructure

Score: 1 - poor

The numbers for academics, researchers, and technical personnel at LMA are high, but organisation of the management of research is not clear, the same holds for the long-term strategic and financial resource planning. The steps needed for improving research performance as well as collaboration with industry are not well defined. The work is carried out mainly in facilities which are rather old and require further improvement. The ratio of students involved in research to the overall number of staff members is very low. LMA does not

demonstrate the strategy to ensure open access to research results. It seems that LMA is still only in the process of creating a nationally comparable research environment.

Development potential

Score: 2 - adequate

It seems that LMA has not analysed its poor performance in terms of low scientific publication output, low international exposure and low interaction with industry. This has a negative impact on the development potential. The size of LMA is sufficient, but its ability to attract high-level doctoral students and scientists from abroad is yet to be established. The ratio of public to private funding is high, but both numbers are very low. Research performed at LMA has a good component relevant to national needs. Involvement in international collaboration projects and networks is limited and needs to be increased. Overall, LMA is capable of being a visible local player, with some potential to contribute to the activities of the international scientific community.

Potential to offer doctoral studies

LMA does not offer Doctoral degrees but is planning to do so in the near future, through a program in "Maritime Transport". The potential to offer a doctoral program of high quality has not been convincingly demonstrated due to the reasons explained in the previous sections, especially on research quality.

Alignment with Smart Specialisation Strategy

Research at LMA is marginally in line with the development priorities and areas of the Smart Specialisation Strategy. Some links to the specialization area "Smart materials, technologies and engineering systems" do exist, but not fully proven yet and limited interaction with industry also prohibits having contribution to the strategy.

Conformity with state scientific and technology development

Research and education activities at LMA are not yet in line with the achievement of the relevant national policy goals regarding RIS3, industrial development and the quality of education in Latvia mainly due to poor quality of the research.

Recommendations

LMA should continue its activities in providing mainly education and training; they are unique in the country in this area and they still have to play an important role in regards to training/education, society and economy.

Additional recommendations related to improving the research potential:

- Stronger leadership and operational management are needed. This might be improved by assigning a dedicated "manager of research and international collaboration" with relevant qualifications and dedication and with a vision to create a shared and well-developed research environment.
- Poor publication track might be improved by specific training. Paper writing skills training delivered by internationally recognized scholars might be organized.
- The composition and quality of research staff could be improved by gradually replacing people from the "old generation" with more recent PhD holders. Succession planning is needed to achieve this.
- The physical research infrastructure needs to be improved through the establishment of new laboratories. This activity is already ongoing.
- LMA should establish close research collaborations with other institutions, both in Latvia (e.g. RTU) and abroad, e.g. in the areas of digitalisation, cyber security, and maritime

transport. As a first step they should aspire to become partners in European projects; next, they should aspire to lead international collaborations.

- LMA should focus on research areas that are unique to maritime studies and of technical problem solving. There is not much point in competing with other national players e.g. in the field of structural mechanics and materials, environmental engineering, etc.
- LMA needs to work harder to seek external funding through collaborations at the European level with countries where maritime culture, education and research is already mature.
- Instead of trying to offer autonomous doctoral education, LMA could consider developing a joint doctoral programme with other institutes, e.g. RTU.

E_4 Rezekne Academy of Technology Institute of Engineering

Institution data

Rezekne Academy of Technology Institute of Engineering	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering, Mechanical engineering, Materials engineering Environmental engineering, Other engineering and technologies including food and beverage technology or food and beverage technology
No. FTE academic personnel 2018	4.2
No. FTE academic research personnel 2018	5.7
Total number of FTE academic and research personnel 2018	9.9
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	69
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	24
Monographs in period 2013-2018	-
Patents Latvian in period 2013-2018	4
Patents (Europe and international) in period 2013-2018	-
Total no. of self-reported outputs in period 2013-2018	97
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	6.97
No. of all outputs in period 2013-2018 per researcher in 2018	9.8
No of PhDs completed 2013-2018	4
No. of PhDs in period 2013-2018 per researcher in 2018	0.4
Total funding 2013 -2018 (Euros)	705,347
Total funding in period 2013-2018 per researcher in 2018 (Euros)	71,247

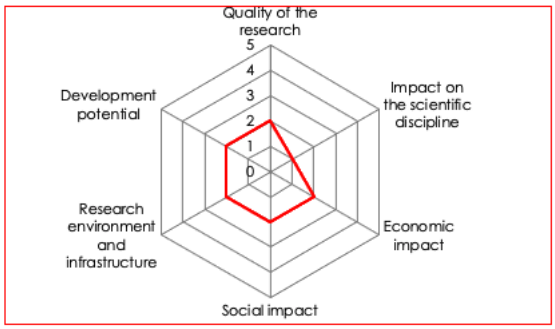
Institute of Engineering is substructure of Faculty of Engineering of Rezekne Academy of Technologies. Research focuses on the following areas: unmanned and autonomous systems, remote sensing, LiDAR, nano-coatings, 3D printing (new materials and laser application), sensor technologies, composites of fibrous plant materials, technologies for reducing greenhouse gas emissions, gas emission minimization, IoT, artificial intelligence, robotization, industry safety, research and sustainable use of local natural resource, innovative sensor systems, risk analysis, safety modelling, cybersecurity, local resources, laser technologies, laser safety, manufacturing automation and optimization.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 4 E_4 Rezekne Academy of Technology Institute of Engineering– Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	1
Economic impact	2
Social impact	2
Research environment and infrastructure	2
Development potential	2
OVERALL SCORE	**2**



Overall score

Score: 2 – adequate level of research

The institute is a satisfactory national player. The institute's research impact is weak in the international scientific context. The quality of research is low, the scientific impact is very limited, and the economic impact is not demonstrated. The social impact has some potential to become important for society, with the training component at a good level. However, the research activities are characterised by a moderate level of interaction with the private/public and policy makers.

Quality of Research

Score: 2 - adequate

The institute aims to support the industrial development of East Latvia in laser technologies and material engineering. A strategic plan exists which is good in principle, but the focus of the research is wide ranging given as a list of over 25 topics including substantial topics such as IoT, AI etc. This does not appear realistic when the resources available are considered, in particular, the number of staff.

Some areas (e.g. laser technology) are of recognizable quality through research collaborations (e.g. Horizon 2020 project) and publications in high impact journals, but other areas do not show obvious research activity. Overall, the institute has a low publication record in peer reviewed journals and most papers are published in regional journals and conference proceedings.

The international profile of the researchers is low, as evidenced by limited exchanges and sabbatical leaves and limited membership in editorial boards.

Although the publishing strategy is towards the international scientific community, the institute has to strive to follow the strategy and to achieve status as a recognised member of the discipline.

Overall, the institute is a satisfactory national player with a few regional collaborations. The Panel deems the significance of the research by the institute to be acceptable.

Impact on the scientific discipline

Score: 1 - poor

There is a wide range of topics listed in the research strategy but little information was provided on the impact of the institute's activities on these topics in the wider scientific field.

The institute has developed active communication with a limited number of EU universities. It is participating in 2 ERASMUS programs that are not research programs. The collaboration that has been developed with two Universities from Bulgaria and Serbia and with a technical school is mainly on courses and as a partner in a proposal for Horizon 2020 project. However, the last effort was not successful (no funding received).

Some foreign cooperation is ongoing in specific sub-fields (laser applications), but the specific nature of the research in laser technology, for example, the innovation is not well demonstrated. The list of best publications does not appear to contain seminal contributions to the field. Overall, there is clearly significant room for improvement in all fields, for producing high quality research publications.

The publishing activity and scientific impact of the institute are predominantly geared towards the national scientific community and has limited impact.

Economic impact

Score: 2 - adequate

The institute has made good efforts to increase its economic impact by developing collaboration with two important partners: The State Land Services of Latvia (national); and the

ROFIN-SINAR Technologies GmbH and TRUMPF GmbH (international) and other enterprise partners. However, funding from those businesses and the industrial sector is very low.

Although research activity of the institute is important for the economy and the region, it is characterised by a low level of interaction with the private sector. Membership of committees and in scientific advisory boards of non-academic entities is also very limited.

Overall, the research activity at the institute is important for the regional economy, but fruitful interaction with the private sector is yet to be established.

Social impact

Score: 2 - adequate

The institute has made good efforts to increase its social impact by organising information days, educational exhibitions, student scientific and creative competitions in robotics, educational camps and summer schools, participating in engineer days and cooperating with high schools (e.g. with Eastern Latvia Technology High School). It also organises professional development courses for teachers and promotes research results in both regional and national media (radio, TV, press).

Overall, the social impact of the institute's activities is adequate at the level of education and training. However, although research is important for the region and society, research and innovation activities are characterized by a low level of interaction with the private /public sectors/ society and limited contribution to the challenges of the region.

Research environment and infrastructure

Score: 2 - adequate

The development of doctoral and interdisciplinary post graduate programs, training of new researchers, the involvement of bachelor and master students in R&I projects, the establishment of a formal program for industrial internships, organisation of seminars about intellectual property, are all very positive efforts towards creating an appropriate research environment. In addition, new infrastructure was constructed in 2014 and the infrastructure modernization project was completed in 2018.

Although important equipment (3D laser scanning microscope, magnetron sputtering system, laser equipment for cutting, welding and laser engraving) are now available at the institute, the low salaries, the low number of scholarships and funding may inhibit the accomplishment of the research objectives. This is evidenced in the SWOT analysis, where the small number of FTE researchers, the overload of staff and the small number of international researchers, due to small salaries, are inhibitors to an attractive research environment. The staff numbers are small for the research agenda mentioned earlier and there is a large number of technical staff compared to the research staff.

Overall, the institute's research environment is still evolving to achieve a level that is expected by the international scientific community of a respected institute in the institute's disciplines.

Development potential

Score: 2 - adequate

The institute has started working towards identifying core areas of research excellence, and has great ambitions to invest in those areas, to increase funding from industry, to create five workplaces for young researchers, to employ bachelor, master and PhD students in projects, to submit at least one research project each year, to participate in at least two Horizon 2020 projects. The plan for the 2019-2023 period envisions engaging Latvian and EU partners (HEI) into the education process of doctoral study programs, to create a joint doctoral program in "Laser Technologies" together with Bulgarian partners.

Therefore, the institute has a reasonably clear vision for the future and a well-defined long-term strategic and financial resource planning, including a human resource development strategy. However, these plans are very ambitious taking into consideration the realistic assessment of the institute's strengths and weaknesses, opportunities, and threats in the provided SWOT analysis. A major risk for the research development that is identified is related to low salaries. Low salaries can be the inhibitors in attracting good researchers, doctoral candidates, and foreign researchers. Therefore, the institute's ability to attract high-level doctoral students and scientists from abroad is yet to be established, while the ability to raise funding from industrial and EU projects has not yet proven.

Overall, the institute has the potential to become a strong national player, capable of being a visible local player in its area of research, and from time to time can be expected to contribute to the activities of the international scientific community.

Potential to offer doctoral studies

The institute has a program of doctoral studies. However, it is impractical to hope that every single research area currently represented in the institute's research portfolio will become a core topic of excellence. The institute needs to establish its niche in the engineering sciences in Latvia. In that regard, with a minimum overlap and the principle of complementarity it should be assessed whether collaboration can be established with, for example, Latvian University of Life Sciences and Technologies / Engineering sciences.

Alignment with Smart Specialisation Strategy

Research at the institute is in line with the development priorities and areas of the Smart Specialisation Strategy, with links to the priority axis "Smart materials, technologies and engineering systems". However, links to Bioeconomy goals of RIS3 are not fully proven yet.

Conformity with state scientific and technology development

Research and education activities are in line with the achievement of the relevant national policy goals regarding RIS3, industrial development and the quality of education in Latvia.

Recommendations

- Considering the broad list of research topics and limited human resources, consider narrowing the research focus and invest more in areas that have demonstrated (e.g. laser technology) or have a potential to demonstrate higher quality and impact.
- More emphasis needs to be given to fundamental research in order to achieve a reasonable balance and be able to have a higher impact on the discipline.
- Fundamental and basic researchers should be rewarded and considered for promotions. Recognition and reward of excellence will promote visibility and encourage opportunities for the institute to build on existing areas of strength.
- Visits to pursue experience in centres of excellence abroad should be encouraged.
- Look for potential to increase salaries to attract good quality researchers and open positions for foreign researchers.
- PhD students should be supported by fellowships/scholarships.
- Research objectives in the bioeconomy area need to take into account and differentiate between this and other engineering institutes in Latvia on the topic. In that regard, overlap is not desired, and the principle of complementarity should be observed.
- Stronger leadership and operational management are needed. Assigning a dedicated "manager of research and international collaboration" with relevant qualifications to

enhance cross-section communication and identify potential of existing and/or new resources. This could also support project acquisition and management.

- Instead of trying to offer autonomous doctoral education, the institute could consider developing joint doctoral programmes with other institutions in Latvia and abroad.

E_5 Riga Technical University, Faculty of Civil Engineering

Institution data

Riga Technical University, Faculty of Civil Engineering	
Primary field of science	Engineering and Technology
Corresponding fields of science	Civil engineering
No. FTE academic personnel 2018	27.71
No. FTE academic research personnel 2018	41.42
Total number of FTE academic and research personnel 2018	69.13
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	501
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	413
Monographs in period 2013-2018	5
Patents Latvian in period 2013-2018	29
Patents (Europe and international) in period 2013-2018	2
Total no. of self-reported outputs in period 2013-2018	950
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	7.25
No. of all outputs in period 2013-2018 per researcher in 2018	13.74
No of PhDs completed 2013-2018	40
No. of PhDs in period 2013-2018 per researcher in 2018	0.58
Total funding 2013 -2018 (Euros)	11.431.459
Total funding in period 2013-2018 per researcher in 2018 (Euros)	165.362

The main scientific directions defined by Faculty of Civil Engineering are:

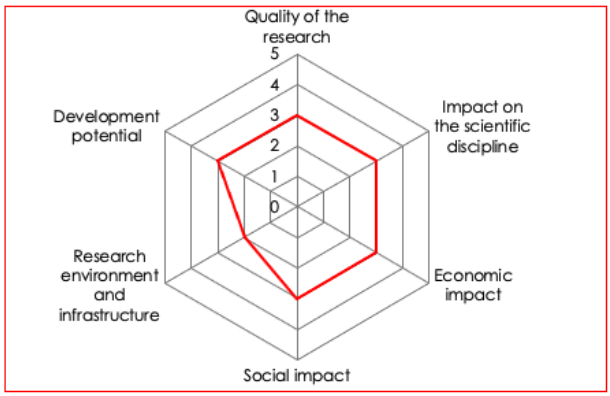
- Building materials, structures and technologies;
- Sustainable and nearly zero energy buildings and effective engineering systems;
- Smart, multifunctional composite materials and structures;
- Road and bridge engineering;
- Water/wastewater treatment technologies, processes in drinking water distribution networks, biotechnologies.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 5 Riga Technical University, Faculty of Civil Engineering – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	3
Social impact	3
Research environment and infrastructure	2
Development potential	3
OVERALL SCORE	**3**



Overall score

Score: 3- good level of research

The Faculty of Civil Engineering (FCE) at RTU is a strong national research player with some international recognition. The quality of research is good, the scientific impact is gradually

growing, and the economic impact is at a good level. The social impact is positive, and the potential for growth is already in place. Some improvements in the infrastructure and research environment will have a positive impact on the quality of research.

Quality of Research

Score: 3 - good

Research at the FCE, focuses on construction materials and structures, sustainable construction and energy efficiency, transportation, and water/waste-water technologies. Researchers of the Faculty have published the results of their research in regional journals, in international journals as well as in conference proceedings. An increasing number of publications appears in good quality international journals. The number of research outputs is average, in absolute terms, but high if numbers are normalized per researcher. Numbers of research outputs and citations in Scopus/Web of Science (WoS) are good. Training provided to doctoral students has been satisfactory. The international profile of researchers, as evidenced e.g. by invited lectures, editorial boards, awards etc. is moderate. Overall, the Faculty of Civil Engineering is a strong national player, with some international recognition.

Impact on the scientific discipline

Score: 3 - good

The specific scientific discipline covered by FCE is well defined. The number of publications in high quality international journals with high impact is average, but numbers show a positive growth rate. Hirsch-index scores of the researchers are moderate. On a positive side FCE has abandoned publication of its own journals with no or limited impact and kept only journals with higher impact. The publication strategy is to aim for higher impact journals, but further effort is needed to support that strategy and thus further increase impact on the scientific discipline. Collaboration at the national level is good. Efforts with foreign collaborators have been moderate but increasing and FCE participates also in Horizon 2020 projects. Overall, the Faculty of Civil Engineering is a strong national player, with some international recognition.

Economic impact

Score: 3 - good

The FCE has brought a positive impact on the economy by strengthening the construction sector in the country. It registers a few Latvian patents on an annual basis. Publications with users are limited, but slightly better than in the previous evaluation period. FCE contributes to the economy with the production of graduates, but it is not clear if doctoral graduates have been employed heavily in business or in public services yet, but the establishment of a few spin-offs is a positive aspect. Collaboration, visits and interaction with the private sector are good. However, membership in committees and in scientific advisory boards of non-academic entities is rather limited (at the international level). Overall, the research of the Faculty of Civil Engineering is important for the economy.

Social impact

Score: 3 - good

The social impact of the research at the FCE is positive, e.g. with regards to advanced materials, construction-related research, water/waste-water technologies (especially water quality monitoring) etc. Collaboration is more active in training (e.g. social partners participate in examination of graduates and benefit by employing graduates of the faculty) or monitoring services rather than research. Overall, the research of FCE is important for society; the Faculty's interaction with the public and policy makers (e.g. standardization bodies) is at a good level.

Research environment and infrastructure

Score: 2 - adequate

From the perspective of the research environment some positive aspects can be observed. The numbers for academics, researchers, administrative and technical personnel in the Faculty of Civil Engineering are at a good level. Organisation of the management of research is at a good level; the same holds for the long-term strategic and financial resource planning. The ratio of students involved in research to the overall number of staff members is reasonable. The Faculty demonstrates the ability to ensure open access to research results.

What regards the research infrastructure - the work is carried out mainly in laboratories with average equipment and further improvements are needed and are ongoing. Infrastructure development funding distribution and internal processes and principles for that are unclear. A clear policy for that was not demonstrated. Overall, the Faculty provides a research environment and infrastructure that is still evolving to achieve a level that is comparable with globally recognised civil engineering departments.

Development potential

Score: 3 - good

The FCE has a reasonably clear vision for the future and reasonably well defined plans. Strengths, weaknesses, opportunities and threats are realistically assessed. The size of the Faculty is sufficient, but its ability to attract high-level doctoral students and scientists from abroad is limited. The ratio of public to private funding is medium to average. The fact that a good portion of international funding comes from EC framework projects is positive; the faculty should become more proactive to join and start EC projects and programs. Research conducted by the Faculty has a good component relevant to national needs. Involvement in international collaboration projects and networks is evolving. Overall, the FCE is capable of remaining a visible local player in its area of research, with a good potential to become a trustworthy partner within the international scientific community.

Potential to offer doctoral studies

FCE already offers Doctoral degrees and is running a well-structured doctoral program. Hence, the Faculty has a good potential to strengthen their programs in this direction; this is supported by the scale of research and the quality of the infrastructure under development.

Alignment with Smart Specialisation Strategy

Research in the FCE, especially in the field of advanced materials, is in line with development priorities and areas of the Smart Specialisation Strategy (e.g. smart materials, technologies and engineering systems).

Conformity with state scientific and technology development

Research and education activities at the FCE are in line with the achievement of the relevant national policy goals regarding RIS3, industrial development and the quality of education.

Recommendations

Research staff is of good quality. Yet, there is room for improvement by attracting personnel with successful careers abroad. Succession planning may be useful in this direction. FCE should organise more long-term visits abroad and invite well-established scientists from abroad in modern research areas. Introduction of a sabbatical leave program would enable staff members to initiate cooperative projects with international institutes.

The research infrastructure could be improved by establishing a laboratory for in-house large-scale testing of structures. This could enhance the capacity of FCE to perform high quality experimental research. Moreover, a state-of-the-art experimental facility with the capacity to

accommodate large-scale tests will offer potential for research collaborations at the European level, since such facilities are scarce in Europe.

FCE should establish stronger research collaborations with other institutions, mainly abroad, e.g. in the areas of advanced materials, timber engineering, and water/waste-water. They should aspire to lead international collaborations in fields where Latvia has an advantage, e.g. in timber construction.

FCE should consider reducing activities in research areas where competition from other disciplines (e.g. mechanical/chemical engineering) is high. With more focus on selected research themes the overall impact might increase substantially.

E_6 Transport and telecommunication institute

Institution data

Transport and telecommunication institute	
Primary field of science	Engineering and Technology
Corresponding fields of science	Civil engineering, Electrical engineering, electronic engineering, information engineering, Other engineering and technologies, Educational sciences
No. FTE academic personnel 2018	4.18
No. FTE academic research personnel 2018	8.33
Total number of FTE academic and research personnel 2018	12.51
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	234
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	208
Monographs	22
Patents Latvian	5
Patents (Europe and international)	1
Total no. of self-reported outputs	-
No. of WoS or Scopus outputs per researcher	18.71
No. of all outputs per researcher	37.57
No of PhDs completed 2013-2018	14
No. of PhDs per researcher	1,12
Total funding 2013 -2018 (Euros)	2,003,864
Total funding per researcher (Euros)	160,181

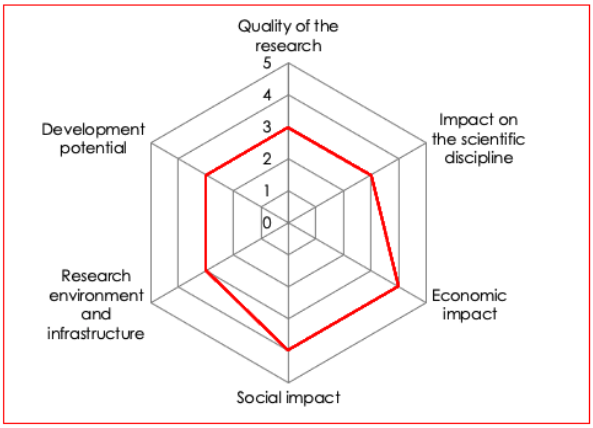
Transport and telecommunication institute (TTI) is a private university of applied science with more than 2800 students and staff up to 150. The main research directions are ICT (telematics), smart solutions in transport and logistics, digital society and economics.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 6 Transport and telecommunication institute - Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	4
Social impact	4
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**3**



Overall score

Score 3 – good level of research

Generating new knowledge is key to the success of the unit, but getting funding for long-term blue-sky research is a challenge in the field of transport development, and application-oriented research (like alternative fuels and hydrogen development scenario simulations, digital solutions like intelligent transport systems and driving, population mobility and satisfaction of passengers). Transport infrastructure is also given as a future research direction. These topics are the subjects of the research roadmap of the unit. The publication output is good, but not more than that. The unit has established a number of international contacts, introduced several educational programs with a proper educational infrastructure, and has the potential to become an internationally recognised institute.

Quality of Research

Score: 3 - good

The research domains of the institute are ICT, smart solutions in transport and logistics, and digital society and economy, all of which align with the RIS3. For each of the topics a brief description is given of its success or its impact. The overall quality of research in TTI is not impressive. There is a relatively low number of internationally renowned top scientists, there are no testified IEEE Fellows, low number of both national and international awards obtained during the evaluation period, a low number of high h-index scientists and a low number of great scientific and technological contributions.

The self-assessment report states that funding obtained by the TTI and its staff increasingly depends upon private contributions (fees), and research contributions from agencies or companies.

Building up the necessary research reputation is a process that takes time and requires careful monitoring of progress. TTI publishes the transport and telecommunication journal (being the editor), which is included in Scopus since 2008, and also in WoS, and will have an impact factor in 2021. The average citation index of the researchers remains low despite the relatively high number of the publications per researcher. During the assessment period there were 14 successfully defended PhD theses, around 2.3 per year. The quality and impact of the publications is low as testified by the average number of publications per awarded PhD-thesis, the output in research papers per permanent staff member and the average/median h-index, counting number of publications does not reflect their quality and international recognition.

Impact on the scientific discipline

Score: 3 - good

The relevance of the research activity in: Information and Communication Technologies (ICT) or Telematics, Smart Solutions in Transport and Logistics, Digital Society and Economy work is contributing within Latvia but outside Latvia is less visible. The scientific output in the top 10% most cited publications with high impact is about 8% of the total amount of the publications. The total number of publications during the assessment on the annual basis was reduced. There are 6 patents (5-national, only 1-international) according to the self-assessment report. Currently the average number of accomplished PhDs is relatively low – 2.3 per/year.

Economic impact

Score: 4 – very good

The main economic aim of the unit is to develop educational programmes, student involvement, doctoral programme, and women in STEM and this is well achieved. The unit has national and international university partners, as well as industry partners, including Riga International Airport, Accenture, Association of Cities of Latvia and Ministry of Transport. Particularly, the Ministry of Transport cooperates with TTI on the topics related to

decarbonisation, including alternative fuels and hydrogen development scenario simulations, digital solutions like intelligent transport systems and driving, and also on the population mobility and satisfaction of passengers. Transport infrastructure will be a future route. Special attention is given to international collaboration; the goal is to increase participation in international research collaboration with institutions like Fraunhofer. The work on a sustainable transport infrastructure, modelling of the traffic optimisation and traffic management system have a strong economic impact. Lots of work is going on around smart logistics in the format of small projects and services like mobility services, optimisation of intelligent systems. Specialists in logistics and IT are employed after graduating from TSI. Overall, the research areas of the institute are very relevant for the industry and the institute has managed to establish successful collaboration with industry partners.

Social impact

Score: 4 – very good

The unit makes a significant contribution to Latvian society through research activities, education, and a wide range of activities undertaken by TTI staff, students and alumni. They participate in the Latvian ICT association, and others like the Association of European Transport and Informatics Europe. One of the ICT (software) companies provides scholarships and fees to the TTI students. They cover the studies for some students (around 10-12 people) across all courses and levels. It allows to attract talented people to the core part of the team. Around 25 people have come from TTI to the company. They have had good performances from the students, they have contributed useful work like creating a product for an Egyptian client. It leads to joint publications with industry and having joint PhD students. The unit had established various international network contacts, as well as enabling young scientists to attend conferences, workshops. Institute contributes to policy making with its collaboration with the Ministry of Transport. Overall, the social impact of research is very good.

Research environment and infrastructure

Score: 3 - good

The TTI is a private institute, their shareholders are a conglomerate of 20 companies internationally recognised in aviation, called S7 finance (registered in the Netherlands). The shareholders have no influence on research funding distribution, but they advise on applications for aviation. It was established in 2016. Shareholders support TTI in infrastructure, its maintenance, exploitation, consultancy, training the staff, members etc. they are collaborating to develop a new strategy with a UK firm.

In 2015 The International Research Advisory Board for the research establishment of TTI was reorganized. The Board plays an advisory role in the scientific and research agenda, quality of research activities, management, and funding for research of the Institute. TTI invests in infrastructure (mainly for educational purposes) originally using EU funds and other project/contract-based work. They reinvest their income in the development of the university. The HR department supports staff and students with training opportunities and the development of research skills.

The research management processes include numerous councils which handle promotion, doctoral programmes, international scientific advisory board (with international researchers), professor council, these inform the vice-rector of the TTI. The strategy of the institute is set in terms of specific goals, but the actions needed to achieve these goals are not clearly outlined and justified. No clear human resource development strategy is presented to elaborate on how new research personnel will be attracted.

Overall the TSI has a range of equipment and tools which is used for research activities and educational purposes in cooperation with academic and private partners.

Development potential

Score: 3 - good

The TTI has some good results in academic education and has established strategic partnerships with several international academic bodies outside the assessment period. The TSI plans to address the future activities to the needs of the region and stakeholders.

The development of research facilities at the three themes (ICT, Smart Solutions in Transport and Logistics, and Digital Society and Economy) in a concerted effort requires more attention, in particular how to finance them. Finding adequate financing is dependent on the definition of a convincing and ambitious research programme and requires the formulation of clear and relevant research questions for which TTI has the necessary intellectual and managerial capacity.

It is very important that a special attention is focused on international collaboration, the aim is to increase participation in international research programs with institutions like Fraunhofer, and align research agenda accordingly. The vision to be the leading private technical university of applied science in the Baltic sea region demands to identify the necessary improvements in the strategy, for example a collaboration with other national and international research centers. The current situation concerning the international constitution of the permanent staff seems to be by far mostly national and should be evaluated concerning career development. The ratio of female-to-male staff should be increased systematically by affirmative action and by setting targets for new appointments, international hiring is an absolute necessity for this. The developed programmes delivered in English and Latvian would help to establish international cooperation, to attract international researchers in the next 5-10 years. The focus of the business planning process should be supported by more detailed operating strategies containing key performance indicators. It will help all staff to see clearly how their own contribution supports the TTI objectives.

Potential to offer doctoral studies

The TTI reported that they have 2,800 students in total. The teaching staff is around 150 people (not full time); most of them hold a PhD degree and are doing research. The TTI has 60 elected professors; other teachers are invited to teach specific courses from industry or abroad. The professors' time is shared between research and teaching, when calculating FTE to research time. The PhD and research board looks at new directions of research and helps to choose PhD topics.

The unit is private and has a specific business model charging for all levels of studies.

Currently the average number of completed PhDs is relatively low – 2.3 per/year. The low level of graduated PhDs is caused by several factors, including the fact that PhDs have other responsibilities either at the TTI or other jobs that prevent from fully focusing on PhD studies. PhD students should be able to devote full time to their doctoral studies.

Alignment with Smart Specialisation Strategy

The Research Programme of the unit corresponds to the national priority of Latvia "Growth of the national economy" by strengthening research and facilitating knowledge transfer between higher education, science and the private sector. The research domains of TTI are: the ICT, smart solutions in transport and logistics, digital society and economy, all of which are aligned with the RIS3 and are the key elements of the strategy. Each domain has professors and leading researchers, they also actively involve PhD students and MSc students working in each domain.

The proposed activities in the TTI Research Program resulted in the increased number of researchers and students in the field of ICT in transport (including master and PhD students).

Conformity with state scientific and technology development

The most important research projects the TTI has carried out with non-university partners, e.g. are the consulting projects in traffic modelling for Latvian municipalities, "Transport and passenger flow organisation model development for Riga international coach terminal" for Riga International Bus Terminal, numerous traffic flow analyses for real-estate companies as well as, several innovative international projects under a non-disclosure agreement. Research directions of TTI have been entirely in line with two strategic documents of Latvia: "Science, Technology Development and Innovation guidelines for 2014 – 2020" and "National Development Plan of Latvia for 2014-2020".

The unit is able to attract PhD students, due to the established PhD study program. Future industry collaboration is developing in the satellite communication field, involving international collaboration. The performance of the unit demonstrates good potential in scientific leadership.

Recommendations

The scientific output is under pressure due to the educational load of the research staff, which has to be matched by a sufficient increase of permanent staff, just to increase the number and quality of the peer reviewed publications to facilitate an increase in reputation and high output of high value publications.

The ratio of junior professors to senior professors (young assistant professors vs. associate and full professors) is generally not balanced and should be considered to meet the most desirable level. Junior professors are very important because of their dynamism, both in the sense of engaging in novel domains of research and in the production of research and technological output. To achieve this, the consistent tenure track programme, sabbatical visits, international exchange programs are necessary.

It is recommended to develop the strategy of having part-time TTI and academic/Industry staff members who should better support the quality of research and number of publications of the junior staff addressing topics of immediate needs of (local) industry to enhance its reputation, raise its profile and further develop its already national standing.

In view of the almost systematic dismantling of transport and telecommunication research facilities by the companies the research facilities at the TTI have acquired a much higher importance as a site of knowledge and technical expertise for the Latvian and the European society than before. It is recommended to increase the viability of the unit for specific areas by focussing on theoretically and practically relevant topics and investing in research infrastructure.

E_7 Riga Technical University, Faculty of Electronics and Telecommunications

Institution data

Riga Technical University, Faculty of Electronics and Telecommunications	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering,
No. FTE academic personnel 2018	10.82
No. FTE academic research personnel 2018	28.05
Total number of FTE academic and research personnel 2018	38.87
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	303
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	97
Monographs	5
Patents Latvian	8
Patents (Europe and international)	-
Total no. of self-reported outputs	413
No. of WoS or Scopus outputs per researcher	7.8
No. of all outputs per researcher	10.63
No of PhDs completed 2013-2018	25
No. of PhDs per researcher	0.64
Total funding 2013 -2018 (Euros)	3,313,716
Total funding per researcher (Euros)	85,251

RTU Faculty of Electronics and Telecommunications is the largest research body in field of telecommunications and electronics technology in Latvia. It operates two main research directions:

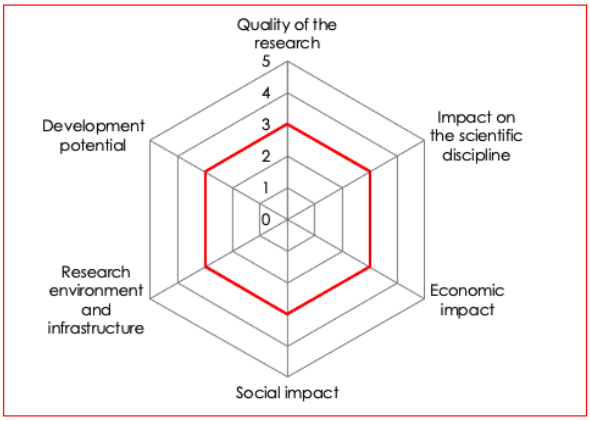
- FET IT - fiber optical communication networks, wired and wireless networks, sensing, data collection, IoT applications, 4G/5G technologies for telecommunications and transport, DSP and machine learning applications for computer networks.
- FET IR - autonomous WSN, wireless power transfer/harvesting, applications of chaos for the improvement of communication system performance, efficient low EMI switching power converters.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 7 Riga Technical University, Faculty of Electronics and Telecommunications – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	3
Social impact	3
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**3**



Overall score

Score: 3 – good level of research

The Faculty of Electronics and Telecommunications (FET) is divided into the Institute of Telecommunications (IT) and Institute of Radioelectronics (IR) supported by the Latvian Electronic Equipment Testing Center.

The IT main R&D focus is on fibre optical communications networks and wireless communications. In those domains, the performance is very good, particularly in the Latvian context. The IR activities, which overlap with IT activities, are spread over many subjects - autonomous wireless sensor networks, multicarrier modulation formats in communication systems, wireless power transfer and harvesting, chaos phenomena for communication system performance improvement, switching power converters, low EMI switching power converters - with limited interconnections and synergy between each.

The quality of research is good, it has a strong role at national level, but international cooperation and impact on the discipline needs to be improved. Economic impact is good. The faculty actively collaborates with the industry, but overall industry investment in collaboration is rather small. The faculty possess good research infrastructure, but needs to address some issues in the research environment, in particular teaching/research balance. Overall, the Faculty is a strong national player with some international activity.

Quality of Research

Score: 3 – good

The Faculty is the principal national player and one of the top regional institutions in the Telecommunications domain. However, at international level, the Institution fails to impose itself in the IT domain, in spite of the good quality in some of its preferred research areas, such as fibre optical communications networks and wireless communications, revealed by papers published in international high-impact journals and projects with and for Latvian companies.

Overall, the international impact of the R&D is low, which can be explained by insufficient dissemination of results in high impact publication journals and failure to research and develop the essential issues in IT and IR. The average Field-Weighted Citation Impact (FWCI) for journal publications is 0.71 i.e. below 1. The overall H-indexes of the leading scientists range from 2 to 14, mostly around 6 on average, which are rather low and also indicators of the poor dissemination and impact of the R&D.

Within 15 most important publications selected by the institution (Section 3.3 of the self-assessment: most important/impactful publications by academic personnel and researchers) only 6 are in journals and thus the scientific output is rather limited and some of the research topics did not seem to have produced any publication.

The Faculty is the largest national research body in the field of telecommunications and electronics technology in Latvia. To summarise, the Faculty is a strong national player with some international recognition.

Impact on the scientific discipline

Score: 3 – good

According to self-assessment section "5.4. Most important foreign collaborators after 2013", the Faculty has international collaborations with institutions from many European countries, China and Kazakhstan. The number of collaborations has been increasing but the common R&D produced a small number of joint publications. The projects involved in the collaborations were mostly in the context of Postdocs and although joint proposals to EU funded projects were submitted none was successful.

The employees of the Faculty are mainly recruited from among the Faculty's own graduates. There is no policy to develop international recruitment and there is an urgent need to address the recruitment situation.

Overall, the international impact of the R&D is limited, which can be explained by insufficient dissemination and the choice of research and development topics being addressed, namely, in fibre optical communications networks and wireless communications for which it has a very good laboratory infrastructure. The Institution has potential to achieve higher international visibility, but that is an objective that requires further effort, especially striving towards higher impact publications.

Economic impact

Score: 3 – good

The Faculty's impact on the economy depends on its ability to add value beyond that provided by the ICT companies and operators and on its ability to develop and transfer technologies from R&D to user companies. A potential positive impact exists from the research and development being pursued. The Faculty reports on collaborations with the following 13 private enterprises: Latvian Mobile Telephone, Ltd. (LMT); TELE2 Ltd.; Mikrotīkls Ltd. (MikroTik); Arcus Elektronika, Ltd.; Smart Engineering Systems, Transport and Energy Competencies Centre, Ltd.; SAF Tehnika, SC; Intelligent Systems, Ltd.; Advangrid, Ltd.; AFFOC Solutions, Ltd.; Baltic Dators, Ltd.; Lattelecom, Ltd.; EuroLCDs, Ltd.; and Lafivents, Ltd. However, the amount of funding received is rather modest i.e. a total of around 203 k Euro in the period under the assessment. The collaboration with the companies involves mainly consulting, knowledge sharing, lecturing, and students' hosting by the companies.

The research results have been protected with 8 registered Latvian patents. The areas covered by the patents are not given. Similarly, it is not detailed whether these patents have been commercially utilized by the companies and if yes, what their economic impact have been.

Several members of the Faculty hold positions in companies that should make it easier to establish collaborations with ICT stakeholders in the private sector.

Social impact

Score: 3 – good

The Institution promotes social equality, integration, and gender equality by taking them into account when selecting a project team. Through articles in Latvian magazines and radio or television broadcasts, the Institution promotes also public understanding of the significance of scientific activity, and is an important educator of BSc, MSc, and PhD students.

The Faculty cooperates with the Latvian Academy of Sciences, The State Joint-Stock Company Latvia State Radio and Television Centre, Electronic Communications Office of Latvia, and The Public Utilities Commission of Latvia namely in ICT policy planning. Thus, having a direct social impact.

Research and development activities of the Institution, namely in ICT, may contribute more to the better quality of life for Latvian citizens by providing access to better products and services. To achieve this goal, it is necessary that the R&D addresses not only current needs but also innovates and that the corresponding output is transferred to companies and to final users. Patent registration and its commercial exploitation is encouraged both as a source of income for the Institution and as an indicator of the R&D quality and of its social impact.

Research environment and infrastructure

Score: 3 – good

In terms of research infrastructure, the Faculty provides laboratory facilities of an international standard, for optical fibres transmission R&D. It provides an effective management of the research structure. There was an impressive investment of 6.36 M for full reconstruction and 1.58 M for infrastructure development, which provides facilities to enable international level research.

In terms of the research environment, the academic staff, whose average age is low (34 years), is said to be overloaded with teaching and administrative work - some positions are outside the University - which limits their availability and dedication for research and students' supervision on the regular basis. Successful international research activities should be considered when allocating responsibilities.

The Institution supports the Open Access approach, namely for generated data and scientific publications.

Development potential

Score: 3 – good

The Faculty and the researchers seem to be aware of the importance in participating in international competition both the one that has to do with the peer evaluation of their research and the one related with submission of joint proposals to EU funded projects. However, the capability of the selected scientific objectives and research themes to impact the international scientific community and society at large seems questionable. The cause for this may be because important topics (problems) have been addressed but not in a way that produces impact because the most important, state-of-the-art topics have not been addressed. This means that it may prove necessary to rethink ongoing research and eventually change and focus R&D activities. New research directions may prove to be necessary to achieve the Faculty's goals.

In its development plan, the FET identifies 11 objectives, but most of them are difficult to be achieved if some of the weaknesses and threats mentioned in the SWOT analysis are not overcome. These should be addressed urgently. If this is performed, the institution has the potential to become a successful international player.

Potential to offer doctoral studies

The Institution seems to have good basics to attract PhD students. The Faculty provides training in 2 doctoral programmes, Telecommunications, and Electronics, and an important part of its current research strategy implementation is the transition to industrial PhD studies. The gap in the funding of doctoral training reduced the PhD completion rate and this problem should be addressed.

Alignment with Smart Specialisation Strategy

The Institution works within objectives of RIS3 specialization area ICT by working on photonics, micro- and nano- electronic technologies, advanced materials, and smart cities and make a significant contribution to the realization of these objectives.

Conformity with state scientific and technology development

The Faculty successfully attracts young researchers. Around 8% of all students of the FET are PhD students. However, no consistent policy for researcher performance assessment seems to be in place.

The Institution contributes strongly to the modernization of ICT and education in Latvia by researching and teaching subjects like radio over fibre solutions for next generation mobile communication networks and sensor networks.

Recommendations

The Faculty research staff has a young average age, and strong senior leadership is required to keep the institution's R&D coherent and consistent.

The research topics of IR are diverse and unfocused. It is recommended to choose fewer topics and focus resources and efforts on those. This would enhance the R&D quality and lead to higher impact factor publications as well as innovations with higher commercial potential.

The FET, FCSIT, and FPEE have some common R&D interests, and collaboration and sharing of resources among them is recommended to capitalize on potential synergies.

The impact of the unit's research, development and innovation activities should be increased by publication of papers in internationally reputed journals, patents' registration and participation in both national and international projects.

A full tenure track system is recommended for the Faculty staff selection and improvement of the professional level.

It is recommended that students should work for their doctoral research full-time, i.e. without the need to encumber their research activities with teaching load.

E_8 Ventspils University of Applied Sciences, Engineering and technology research platform

Institution data

Ventspils University of Applied Sciences, Engineering and technology research platform	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering, Mechanical engineering, Materials engineering, Other engineering and technologies
No. FTE academic personnel 2018	2.07
No. FTE academic research personnel 2018	11.18
Total number of FTE academic and research personnel 2018	13.25
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	157
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	68
Monographs	-
Patents Latvian	4
Patents (Europe and international)	1
Total no. of self-reported outputs	230
No. of WoS or Scopus outputs per researcher	11.85
No. of all outputs per researcher	17.36
No of PhDs completed 2013-2018	4
No. of PhDs per researcher	0.3
Total funding 2013 -2018 (Euros)	14,762,920
Total funding per researcher (Euros)	1,114,351

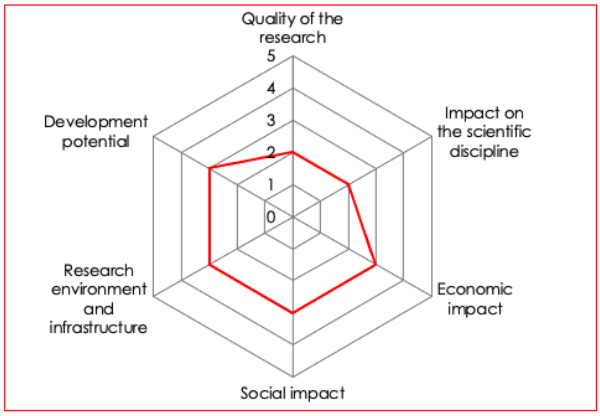
The research covers the following areas: nanosatellite system engineering including small satellite subsystem manufacturing; satellite tracking algorithms and development of satellite navigation system; antenna grid technology and development of antenna grid; radio astronomy data signal processing, radio astronomy data reduction, and imaging algorithms; development of VLBI, LOFAR, SKA hardware and firmware; development of applications and solutions in smart home technology, development of IoT sensor systems for e-Health applications. The institute operates large radio telescopes and carries out research related to their use in astronomy as well as satellite communications. These telescopes are referred to as the symbols of Latvian science.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 8 Ventspils University of Applied Sciences, Engineering and technology research platform – Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	2
Economic impact	3
Social impact	3
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**2**



Overall score

Score: 2 – adequate level of research

With the introduction of novel satellite communication systems, the unit has potential to be an important player in the future. The quality of the research as well as the impact on the scientific discipline are at reasonable levels and could be improved by focusing i.e. careful selection of research topics, and accordingly directing more resources to these selected research topics. Publishing in globally recognised journals is recommended, instead of the current focus on conference proceedings. The unit collaborates with the European Space Agency and with a Swedish Space Company in order to develop future satellite communications. The unit is a national educator of BS and MS students, but it does not operate PhD programs.

Quality of Research

Score: 2 - adequate

This unit operates two radio large telescopes (RT-16 and RT-32) as well as carrying out research related to their use in astronomy and satellite communications. It also carries out modelling experiments e.g. CFD calculations for wind energy production. The main goal of the research is to develop satellite communication subsystems and professional ground stations (primary RT-16, secondary RT-32) for commercial use in the near future and with low frequency arrays, e.g., LOFAR-type radio telescope station with equipment containing nodes of various geodetic and meteorological sensors.

The total number of papers (full text publications) in peer-reviewed scientific edited journals and conference proceedings included in Web of Science or SCOPUS databases is 225 papers, i.e. on average 36 per year. The number of international journal papers is low, as conference proceedings seems the major publication route, with many conferences being held in Latvia. Overall H-indices of the lead scientists are also low, ranging from 2 to 11, with overall number of citations from 13 to 336.

The number of enrolled and defended PhD doctoral thesis is very low and given the staff numbers means there is little supervision input from the staff. Several doctoral students have graduated from the foreign universities after carrying out research and performed teaching at the unit.

To summarise, the institution is a satisfactory national player. The institution occupies an important position in the national scientific community related to astronomy and has some international activities.

Impact on the scientific discipline

Score: 2 - adequate

The main research directions are rather broad as well as diverse in comparison to the number of the scientists working at the unit. There is a wide range of topics and it is not clear which of these topics would be the main focus areas. In other words, the results from the research topics could be higher if there was more focusing, accordingly leading to a larger impact on the scientific discipline. Based on the publications, the international recognition and impact on the discipline is rather modest. However, the unit is engaged in international collaborative research.

Economic impact

Score: 3 - good

The unit has reported collaborations with 8 enterprises. However, the amount of funding included is modest i.e. around 90 K Euros in the 6 year period under assessment. It is claimed that the commercialisation of research has occurred via projects funded by public organisations like ESA, ERDF and the government of Latvia. It is not clear what has been commercialised via these publicly funded projects. The research results have been patented via 4 registered Latvian patents and 1 registered European patent. The areas covered by the patents are not given. Similarly, it has not been reported whether these patents have been commercially utilized by the companies and if yes, what their economic impact have been. The unit has created 2 spin-off companies in the IT, computer vision and security areas.

Social impact

Score: 3 - good

The VIRAC venue in Irbene serves as a popular tourism facility for a wider public, including schoolchildren. Therefore, the telescopes definitely play a significant role in the popularization and public insight into the natural and technical sciences in Latvia. VIRAC has already enabled the creation of new industries in Latvia, like Space, and the expansion of regional companies such as Cryogenics Vacuum Systems (CVS) both with added value activities. The unit also is an important educator of BS and MS students for the local area.

Research environment and infrastructure

Score: 3 - good

In terms of research infrastructure, the large-scale infrastructure operated by VIRAC – 32m and 16m radio telescopes in Irbene – is a unique research facility in the Baltic countries. However, much funding is needed to modernise such expensive infrastructure and is therefore an important national question. The infrastructure needs to be maintained to be used in future research.

In terms of the research environment, clear vision for the future and related research strategy needs to be developed to strengthen international position. Another concern is a very small number of PhD students.

Development potential

Score: 3 - good

There exists development potential and potential to become an international player when selecting carefully narrower research areas with active academic leaders and focusing more effort, e.g. on satellite signal receiving, modern telecommunications and small satellite constellation data network technologies. Especially, which kind of research will bring more direct economic impact in the form of new inventions and later products is a difficult question which needs to be resolved. Research infrastructure needs to be supported to achieve any of the above.

Potential to offer doctoral studies

As the unit does not run a PhD program, the doctoral students have supervisors outside the unit at other universities in Latvia, mainly RTU and University of Latvia. The doctoral students work in VIRAC mainly as engineers and spend much of their time teaching BS and MS courses, and cannot focus on their research. The unit has conditions to host PhD students and thus should initiate or join the PhD education program of other universities.

Alignment with Smart Specialisation Strategy

The Engineering Sciences department aligns within ICT RIS3 objective by working on satellite communication subsystems, ground segments for satellite communication, and other wireless IoT based projects and is making a relevant contribution to the realisation of the strategy objectives.

Conformity with state scientific and technology development

The unit is not performing at a good level to attract PhD students, due to lack of a PhD study program and the underfunding of PhD students. However, industry collaboration is developing in the future satellite communication fields, involving international collaboration.

Recommendations

The research topics of the unit are rather broad as well as diverse. It is recommended to select fewer topics and accordingly have larger resources applied to these topics. The area of small satellite communication technologies is a promising topic.

The collaboration of the unit with international satellite communications organizations should be increased. The collaboration should be based on joint projects with defined objectives, running for a defined time interval and whose results are assessed after they are completed.

The utilization intensity of VIRAC antenna-based infrastructure should be enhanced. Funding to support maintenance of the infrastructure needs to be secured.

Senior researchers as well as PhD students should be able to dedicate if not full time, at least a significant percentage of their time to R&D activities and not be overloaded with academic activities or involved in external private or public activities.

The impact of the unit's research, development and innovation activities should be increased by publications, namely, in international reputed journals, patents' registration and participation in both national and international projects.

A full tenure track system is recommended for the faculty selection.

The unit has conditions to host PhD students and thus should initiate or join the PhD education program of other universities.

E_9 Riga Technical University Faculty of Materials Science and Applied Chemistry

Institution data

Riga Technical University Faculty of Materials Science and Applied Chemistry (FMSAC)	
Primary field of science	Engineering and Technology
Corresponding fields of science	
No. FTE academic personnel 2018	22.37
No. FTE academic research personnel 2018	98.13
Total number of FTE academic and research personnel 2018	120.5
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	947
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	528
Monographs	5
Patents Latvian	53
Patents (Europe and international)	7
Total no. of self-reported outputs	1,540
No. of WoS or Scopus outputs per researcher	9.86
No. of all outputs per researcher	12.78
No of PhDs completed 2013-2018	64
No. of PhDs per researcher	0.53
Total funding 2013 -2018 (Euros)	18,593,653
Total funding per researcher (Euros)	154,304

Riga Technical University Faculty of Materials Science and Applied Chemistry (FMSAC) is the leading centre of materials science and chemical engineering in Latvia Main focus areas of FMSAC are:

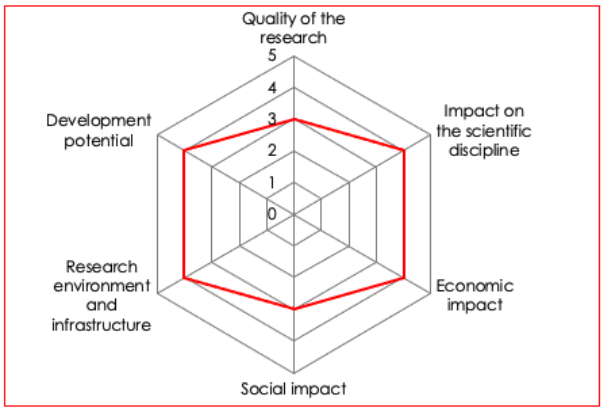
- Biomaterials research
- Design and textile technologies, smart textile and clothing
- Inorganic materials (including their physics)
- Organic chemistry (broadly defined: biologically active compounds, biofuels, catalysts, organic and hybrid functional materials, organic materials for photonics)
- Polymers & composite materials (including their physics)

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 9 Riga Technical University Faculty of Materials Science and Applied Chemistry – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	4
Economic impact	4
Social impact	3
Research environment and infrastructure	4
Development potential	4
OVERALL SCORE	**4**



Overall score

Score: 4 – very good level of research

The unit has published papers in medium impact factor journals, with some published at very high impact factor ones. The h indexes of researchers are average with some high points. The publications have been cited about 1140 times during the review period. The unit is an active collaborator with the private sector, i.e. 113 cooperation agreements have been established with companies of all sizes between 2013 and 2018, resulting in private funding. It has patented the results actively. Doctoral training is well organised. The unit has potential to further develop by narrowing the research topics and, in addition, receiving continuous financial support for both infrastructure and personal resources. FMSAC is one of the two leading centres of materials science and chemical engineering in Latvia and provides the only study program with such content in Latvia. Therefore, the produced human resources (alumni) directly improve the overall performance of the Latvian chemical industry, thus having a significant national social impact. Over 17 M€ has been invested in the renovation of buildings and to modernize research equipment in the field of materials science and engineering. Accordingly, the equipment as well as research environment is well up to date internationally.

Quality of Research
Score: 3 - good

The main research directions are i) biomaterials research, ii) design and textile technologies, smart textile and clothing, iii) inorganic materials (including their physics), iv) organic chemistry (broadly defined: biologically active compounds, biofuels, catalysts, organic and hybrid functional materials, organic materials for photonics) and v) polymers & composite materials (including their physics). The average number of papers (full text publications) in peer reviewed scientific edited journals and conference proceedings included in Web of Science or SCOPUS databases has been around 160 papers per year. When normalised by the total number of active academic and research personnel, it is roughly one paper per researcher per year. The papers have been published in journals with impact factors ranging from 2.61 to 30.7, i.e. some papers have been published in high impact factor journals like Energy and Environmental Science and Chemistry of Materials. The typical H-factors range from 6 to 16, however there is one Professor (Kārlis Agris Gross) where the H-factor is high at 38, which is a good value in the international scale. 61 % of the journal publications belong to the Q1 journals. Around 65 PhD thesis have been defended, i.e. on the average around 11 per year. Accordingly, each of the academics would have tutored on the average from 2 to 3 graduated PhD students during the 6-year period, which is reasonable within the fields of the unit.

Impact on the scientific discipline
Score: 4 – very good

The average Field-Weighted Citation Impact (FWCI) for journal publications is 0.86 i.e. close to 1 and the total number of citations is 1139 i.e. on the average around 190 per year. The overall citations by individual scientists range from 125 to 1108, with the exception of 4802 citations by Professor Kārlis Agris Gross. One of the main focus areas with the chemical engineering field with good scientific impact is biomaterials for bone tissue replacement and regeneration, eco material/environmentally friendly material development and research, including the exploration of Latvian natural resources as well as biotechnology and bioreactor design. Here a strong collaboration with physicians and pathologists in Latvia and abroad is established. Both researchers as well as students participate actively in international conferences and join international research projects. The unit has coordinated and joined as a partner many EU framework program and Eranet projects. Accordingly, the impact on the scientific discipline has been at a very good level and the faculty is a strong international player.

Economic impact
Score: 4 – very good

The unit is an active collaborator with the private sector, i.e. 113 cooperation agreements have been concluded with companies of all sizes between 2013 and 2018, with private funding being involved. The funding from private companies was about 1 M€ for 2013-18. The main contract research projects were implemented for the pharmaceutical, polymer, construction and textile industries. Technologies, elaborated for the industries, are considering sustainability aspects, such as reuse of waste, reduction of energy consumption, increase of energy efficiency, etc. In addition, the research results have been patented with a total of 60 registered patents, 7 being European patents. FMSAC is the leading centre of materials science and chemical engineering and produces knowledge (scientific results/technologies) which directly improves the overall performance of the Latvian chemical industry and accordingly the economy.

Social impact
Score: 3 - good

FMSAC is one of the two leading centres of materials science and chemical engineering in Latvia and provides the only study programs with such content in Latvia. Therefore, the produced human resources (alumni) directly improve the overall performance of the Latvian chemical industry, thus having a significant national social impact. The unit has graduated 292 MSc students and 64 PhD students during the evaluation period. The unit has made contributions to policy planning and evaluation for the Latvian Council of Science, European Chemicals Agency (ECHA) and Latvian Academy of Sciences. However, beyond the contribution in the form of human resources and policy planning, direct social impact of the research is not that evident.

Research environment and infrastructure
Score: 4 – very good

Over 17 M€ has been invested to the renovation of buildings and to modernize research equipment in the field of materials science and engineering. Accordingly, the equipment is well up to date internationally. FMSAC has important microscopy facilities which are needed in their research, including AFM and SEM. The TEM microscope which is needed for high impact factor publications is available via a national shared equipment center. The use of the research infrastructure and the equipment complies with the research programs of FMSAC and the RTU Research Platforms in which FMSAC actively participates. The infrastructure seems sustainable, with a well-defined organisation and logical management structure.

Research environment is very well organized as well. The leadership of the faculty demonstrated long-term strategy very well both in the self-assessment and during the visit.

Development potential
Score: 4 – very good

Based on the facts outlined above FMSAC has a good potential to become a strong international player. However, there are challenges in doing that because of the broad coverage of research areas when compared to the number of personnel. With streamlining i.e. narrowing both the research areas as well as the related organization structure, improvement is possible. This will increase the number of Scopus listed papers as well as the publication of a higher number of high impact factor papers. It is recommended to increase the number of non-Latvian scientists, as well as the longer period visits by the unit's staff to high level research units outside Latvia to further establish recognition of FMSAC.

Potential to offer doctoral studies

During the period of 2013-2018 three Bachelor's study programs and two Master's and PhD study programs were opened to foreign students. Every year these study programs attract an increasing number of students (2 (2013) → 18 (2018)). Visiting professors and researchers (5.2 FTE; 12 persons) have worked at FMSAC and enhanced competitiveness and internationalization. In the reporting period a teaching project on science based higher education has been granted to FMSAC (1.5 MEUR), the implementation of which started in mid-2019.
The PhD studies are well organised, with students mainly working on their thesis topics. The interviewed students were enthusiastic to learn more, write good quality publications and they have had possibilities to join scientific meetings outside Latvia and collaborate internationally. FMSAC has a very good potential and it should continue offering quality doctoral studies.

Alignment with Smart Specialisation Strategy

FMSAC contributes to the achievement of the objectives and development of the priorities in four out of five RIS3 areas (Smart materials, technology and engineering systems, biomedicine, medical technologies and biotechnology, Smart Energy and Knowledge intensive bioeconomy). FMSAC coordinates RTU research platform "Materials, processes, and technologies", where materials science and chemical engineering interacts with other engineering sciences. FMSAC contribution is not only thematically well aligned, but also relevant in substance and helps to direct Latvian economy towards higher value-added production.

Conformity with state scientific and technology development

FMSAC contributes to the national strategies in several aspects. It trains and provides human resources for research, it has a reasonable quality scientific output, and it strives towards internationalization of research.

Recommendations

FMSAC has achieved good results in terms of the quality of research and it has very good achievements in internationalization as well as collaboration with industry. It has developed a very good research infrastructure and research environment that supports and stimulates good level research. To further strengthen and grow its international position the following is recommended:

- Further streamline i.e. narrow both the research areas as well as the related organizational structure, in order to increase the scientific level and impact.
- Each research group should be led by a professor level scientist and should have a well-defined research focus.
- Professorships should be tenured, i.e. the adaption of tenure track system is recommended.
- Professor level scientists are recommended to have more frequent sabbatical visits to high level laboratories in other countries.
- The doctoral training could be improved to offer doctoral students enough funding that they would not need to have any other job. We recommend the number of students to be further increased to sustain human resources for research.

E_10 Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics

Institution data

Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics (FMETA)	
Primary field of science	Engineering and Technology
Corresponding fields of science	Mechanical engineering, Materials engineering, Medical engineering, Other engineering and technologies: Aerospace engineering
No. FTE academic personnel 2018	24.09
No. FTE academic research personnel 2018	25.97
Total number of FTE academic and research personnel 2018	50.06
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	341
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	230
Monographs in period 2013-2018	8
Patents Latvian in period 2013-2018	35
Patents (Europe and international) in period 2013-2018	5
Total no. of self-reported outputs in period 2013-2018	619
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	6.81
No. of all outputs in period 2013-2018 per researcher in 2018	12.37
No of PhDs completed 2013-2018	37
No. of PhDs in period 2013-2018 per researcher in 2018	0.74
Total funding 2013 -2018 (Euros)	6,288,739
Total funding in period 2013-2018 per researcher in 2018 (Euros)	125,624

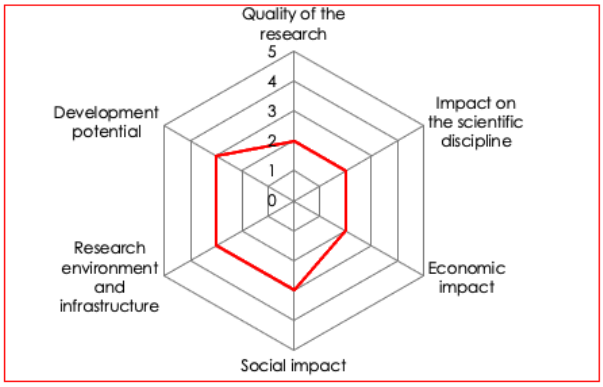
The main research directions of the FMETA are mechanical engineering and machinery, civil transportation, including automotive, railroad and aviation transport, and biomedical engineering.

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 10 Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics – Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	2
Economic impact	2
Social impact	3
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**2**



Overall score

Score: 2 – adequate level of research

The FMETAs is the only institution in Latvia that provides PhD and post-doctoral training in the fields of mechanical engineering, machine design, manufacturing engineering, land, water

and aviation transport, biomedical engineering. The quality of the research is adequate with some areas at a good level, but most are still struggling to achieve high international impact. The leadership in several domains needs to be enhanced and attuned to new opportunities, changing technologies and changing societal demands, thereby utilizing their potential as much as possible. The FMETA should adapt their organisation to changing circumstances, both for internal reasons (evaluations) and external ones (changes in the funding environment, technological changes, changes in the industrial environment).

Quality of Research
Score 2: adequate

There are several individual researchers who are the key investigators and are raising research to the international level, but in general the outputs fail to establish FMETA as a well recognized international player. Although the self-assessment report covers the research areas presently active in FMETA, it does not offer an adequate view on what future technological and research challenges these areas will pursue. There are insufficient leading human and financial resources for regular competitive project applications, resulting in a high uncertainty in planning research. FMETA is not taking part in any Horizon 2020 project. There is a weak documentation of cooperation with the international academic or industrial community. The number of publications in the leading journals with a high impact factor /cited publications per researcher is low which is a serious drawback. There are no established exchange programs or any policy on sabbatical leave. Overall, FMETA is trying to reach international audiences with some quality work, but limited resources prohibit from achieving better results.

Impact on the scientific discipline
Score 2: adequate

The FMETA's impact remains relatively low due the low number of the publications, in particular in top academic journals. Also, international cooperation is limited. Most of the research staff are part-time and the scope of the research areas is rather dispersed and fragmental. There are almost no scientists with internationally recognised expertise and capacity to successfully lead research, or leaders with a strong international network and strong reputation. The PhD students are generally part-time employees, and are not financed by the state or RTU, they have some scholarships, e.g. they are partly employed and financed from the projects, and are partly paid by the department. Thus, they have limited capacity to expand the established research fields.

Economic impact
Score 2: adequate

The FMETA scientific activity develops technologies and products for Latvian enterprises, and provides evaluation, testing and technical expertise. The total project funding is around 4M EUR in total including 500k EUR from private funding which remains to be rather limited and indicates insignificant impact of the research taking into account the applied nature of the research performed at the FMETA. Indirect economic impact is more relevant. FMETA is relevant for providing higher education and graduates relevant for the Latvian businesses. According to the self-assessment annually on average 200 BSc and 90 MSc STEM professionals graduate from FMETA .

Social impact
Score 3: good

The research activity of the unit has a good social impact, the unit produces a reasonable number of publications recognisable at the national level. According to the self-assessment the FMETA cooperates with professional organizations involved in policy development. In

general, the research is effectively connected with societal interests. Though publications with users are limited and direct collaborations and visits with the business/public sector (state and municipal institutions) are rather restricted. Non- academic collaborations are limited to Latvian associations, but only a few concrete results from these collaborations are evident.

Research environment and infrastructure

Score 3: good

In terms of the research environment, the FMETA has a limited number of academic staff, researchers and support personnel to develop a sustainable common research agenda. Long-term strategic and funding schemes planning, including the human resource development-strategy is rather generic in the self-assessment and was not at all elaborated during the visit. The ratio of students involved in research to the overall number of staff members is reasonable. The post-doctoral training takes place through participation in on-going research projects after finishing the doctoral studies as well as involvement of young PhDs in the teaching process. Post-docs at RTU have access to open lectures and seminars provided by other faculties.

In terms of research infrastructure, the FMETA is comparable with some academic institutions in its discipline and the infrastructure suits its current research needs. Several laboratories like, for example, Bosch car diagnostic laboratory, CNC machining laboratory, gas and heating, SNC laboratory – provide strong basis for collaborations with industry. They receive regular training on exploitation of the machines, operational principles, technological functionalities, ranges of operation, scalability, accessibility for the custom designs by means of modifications of the equipment.

Development potential

Score 3: good

There are insufficient human and financial resources for regular applications for competitive project(s) funding (on the national and international level), resulting in a high uncertainty in planning research budget. A low number of publications in the leading journals with a high impact factor /cited publications per researcher at the scale of the faculty as a whole is a serious drawback. There are no established exchange programs or any policy on the sabbatical leave. Still if the above is addressed the FMETA has a potential to become an international player. It has already established some international networks, secured international competitive funding and with clear strategy can further develop and ensure a more stable role and impact in the international scientific community.

Potential to offer doctoral studies

The FMETA has three doctoral programmes in Latvian and English but there is no clear policy and strategy on enrolling international PhD students. The uncertainty in planning of the research budget makes long-term planning /involvement of PhD students and young researchers difficult. The intensity and the quality of doctoral studies is insufficient since the majority of the PhD students have a full/part-time job outside the FMETA and are not able to focus totally on their studies and research. There are some laboratories with no teaching activity and the synergy and cooperation among the laboratories is weak. The policy towards research contributions, publications of PhD students is not well defined. There is no intermediate assessment of the PhD students and their development criteria. There is a significant reduction of the total number of PhDs during the assessment period while the number of the part-time researchers has increased.

Alignment with Smart Specialisation Strategy

FMETA researchers contribute to the smart specialization areas 'Smart materials, technology and engineering systems', 'Biomedicine, medical technology, biotechnology and bio-pharmacy', 'Smart energy'. The contribution is mainly in the form of providing a research that can help the national economy actors to provide higher value-added products.

Conformity with state scientific and technology development

FMETA scientific activity has an impact on the objectives of the national science, technology and innovation development policy. FMETA is the biggest institution and the main partner in higher education which prepares engineers for the community of mechanical engineering companies being the only university in Latvia that provides PhD and postdoctoral training in the fields of mechanical engineering, machine design, manufacturing engineering, land, water and aviation transport.

Recommendations

Although the unit has research potential (modern equipment, recent investments in new buildings, relevant research topics), special attention should be focused on the strategic development of the research fields. The fundamental economic factors that hold back innovation should be critically evaluated as part of the internal research strategy process. The coordination of the (inter)national and industrial research activities, including strategic planning and development should be an essential part of the future policy.

FMETA should expand its research vision and implement an internationally targeted strategy. For example, increase the impact of its research by increasing the level of the scientific publications and international visibility. Researchers should aim to publish in higher level journals despite the applied nature of the research. In working with industry and commercial collaborators, it is recommended that researchers focus on internationally relevant research questions that create opportunities to publish in high impact journals. This should enable building of international networks and provide better access to competitive international funding.

FMETA should aim at the recruitment of foreign researchers and have a practice of announcing job positions through international agencies.

Consideration should be given to a sabbatical leave program for permanent staff to improve collaboration with other national, international research and academic units.

A better research synergy among the laboratories with complementary research specializations has to be achieved using a better selection of the well-defined discipline specific research topics relating to the researcher's knowledge.

E_11 Riga Technical University Faculty of Power and Electrical Engineering

Institution data

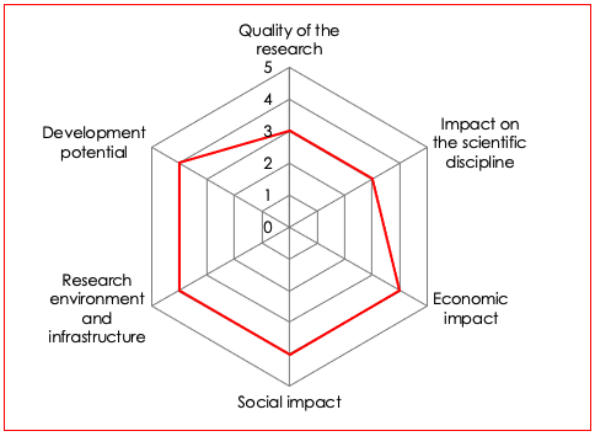
Riga Technical University Faculty of Power and Electrical Engineering	
Primary field of science	Engineering and Technology
Corresponding fields of science	Computer and information sciences, Electrical engineering, electronic engineering, information engineering, Environmental engineering, Environmental biotechnology
No. FTE academic personnel 2018	20.85
No. FTE academic research personnel 2018	52.7
Total number of FTE academic and research personnel 2018	73.55
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	1,982
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	334
Monographs	9
Patents Latvian	35
Patents (Europe and international)	1
Total no. of self-reported outputs	2,361
No. of WoS or Scopus outputs per researcher	26.95
No. of all outputs per researcher	32.1
No of PhDs completed 2013-2018	64
No. of PhDs per researcher	0.87
Total funding 2013 -2018 (Euros)	12,643,652
Total funding per researcher (Euros)	171,906

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 11 Riga Technical University Faculty of Power and Electrical Engineering – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	4
Social impact	4
Research environment and infrastructure	4
Development potential	4
OVERALL SCORE	**4**



Overall score

Score: 4 – very good level of research

The Faculty of Electrical and Environmental Engineering (FPEE) is organised into three main institutes and is carrying out research and development in the overarching theme of energy and the environment. Since the last review, the Faculty has consolidated some of its activities and streamlined its operations. The result has been an improved performance: increased publication research outputs in more recognised databases; an increase in research funding from European competitive programmes; more input into the Latvian economy through established companies as well as start-ups; plus, input into government policies and strategy development.

However, there are several threats to the Faculty's future development which need to be addressed: the age profile of the staff; the lack of international interaction by the staff; the wide range of research topics; and the decreasing number of Masters and Doctoral students. Given the number of personnel, the Faculty covers too large range of research areas to reach the level of a very strong international player. With streamlining i.e. narrowing both the research areas as well as the related organisation structure, improvement is possible.

Quality of Research

Score: 3 – good

The main thrust of the FPEE research is based on energy with the target of producing a low carbon economy in line with national/international policy goals. The Faculty is divided into three institutes, namely, energy systems, electrical engineering and power engineering which together form an energy and environment platform. In the last review the Faculty was assessed as a number of separate institutes but since then there has been consolidation of the institutes' activities.

FPEE has specific plans to improve the output of staff and thereby improve the quality of the research. This has already happened since the last review where the Faculty has taken direct action to improve performance and outputs.

The average number of papers (full text publications) in peer reviewed scientific edited journals included in Web of Science or SCOPUS databases has been around 330 papers per year. When normalised by the total number of active academic and research personnel, this gives over 4 papers per researcher per year. The papers have been published in the journals where the impact factors range from around 1 to 10. The average Field-Weighted Citation Impact for

journal publications is 0.8 i.e. close to 1 and the total number of citations is 1450 i.e. on the average around 240 per year.

FPEE is a leading research institution in the Baltic States in the engineering domain but has yet to achieve a significant impact in the European and international arenas, for example, there has been little success in internationally competitive funding programmes, however, there are some promising signs of international impact. The unit has researchers with international visibility, i.e. 2 scientists with H-index over 22. The application of DC-grids to industrial manufacturing technologies in collaboration with a large international company is quite an original research output.

Some slightly worrying trends can be observed in terms of new generation of researchers. Over the assessment period the number of Master's students have been decreasing which is a worrying trend and should be addressed. For PhD students 139 doctoral students were enrolled over the period with a completion rate of roughly 50 %. Again, a worrying trend which needs to be addressed. Around 65 PhD thesis have been defended, i.e. on the average around 11 per year. The number of academic persons was 74. Accordingly, each of the above academic personnel would have tutored on average less than 1 graduated PhD student during the 6-year period, thus the supervision activities of the staff is not high within the fields of the institute in question. The number of post-doctoral researchers is very small and should be increased.

Impact on the scientific discipline
Score: 3 - good

The main research directions i.e. focus areas are the following: electrical engineering, power engineering, energy conversion and energy efficiency, energy technologies, motion control and robotics, climate change, bioeconomy and biotechonomy, energy policy, system dynamics, sustainability of resources. The research fields are quite broad, even when considering the size of the unit. It is not clear which areas of research have the highest impact.

All three scientific institutes within the unit are part of the Energy and Environment platform. The unit has a significant impact at national level within its field.

There have been successful projects with industry outside Latvia, for example with Daimler to improve energy efficiency in DC supply systems. There have been several spin-off companies related to the Faculty's research in the energy domain. International EU projects and funding are reasonable for a Faculty of this size. There were 43 international projects, with 8 coordinated by FPEE, realising 6.3 M Euros over the assessment period. International collaboration through staff invitations are modest.

The Faculty claims there are no other institutions in the Baltic region which can be considered as competitors and also claim it is its infrastructure which sets it apart.

Economic impact
Score: 4 – very good

The Faculty has been an active collaborator with the private sector, i.e. about 20 cooperative projects have been conducted with companies, with private funding being involved. Overall, the funding from private companies was about 1.5 M€ for the period 2013-18. In addition, the research results have resulted in 35 registered Latvian patents and 1 international patent.

The Faculty has contributed successfully to the commercialisation of research results via the establishment of spin-offs (start-ups) by employees and students of the unit, in particular, SolarDot (2015) – small sized, mobile phone charging stations, using solar energy; Lesla Latvia

(2015) –wireless charging devices, developer of robotics solutions and small electric vehicles and Cozy Cell (2016) - wireless mobile phone chargers. There are several additional possibilities in the process of development, thus, supporting the initiative by the Investment and Development Agency of Latvia to facilitate innovation commercialization activities on a national and international level.

For economic impact FPEE highlights the high percentage of graduates that are employed (over 90%) in Latvia. In 2018 there were 878 students and roughly 10 % in the doctoral programme. These are good employment figures for graduates and in line with what one would expect in this field.

Social impact
Score: 4 – very good

The Faculty is the leading centre and well-known institution of study in the fields of electrical engineering, power engineering, electro mechatronics, thermal engineering, and environmental engineering in Latvia.

The Faculty has graduated close to 600 MS students and 65 PhD students during the evaluation period. Therefore, the human resources (alumni) produced directly improve the performance of the Latvian industry, thus having a significant national social impact.

The Faculty also has an impact on the social well-being of Latvian citizens through its research and development to produce better air and water quality. The staff also contributes through membership in working groups and acting as experts to government departments. The staff provides lectures and seminars to industry and the general public. These are activities that one would expect from such a Faculty and if increased could perhaps encourage more students into the field at all levels.

Research environment and infrastructure
Score: 4 – very good

A new building has been commissioned with a spend of 9.25 M Euros on infrastructure. There are also well-equipped laboratories. FPEE regards its infrastructure as one of its strong and unique facilities. The infrastructure as well as research environment seems to be at the internationally competitive level and should not therefore be an impediment to enhancing international research activities.

FPEE has several laboratories which provide testing facilities for activities involving, for example, energy, robotic and biosystems. The unit has a 6-year plan for replacement of equipment, but little detail is given of how this is to be funded. The laboratories have enabled real time testing to be performed rather than relying on simulation.

Development potential
Score: 4 – very good

FPEE has well defined research goals with clear monitoring indicators: 30 K euro funding per FTE, at least 4 papers per FTE in appropriate databases,10 doctoral thesis per 100 bachelor students, increase in EU funding ratio of 30%. These indicators are not currently being applied. These are realistic targets for staff who are operating at the international level and should be applied. FPEE also has goals for cooperation with industry; 10 patents per year, 20 contracts, at least two start-ups and gaining at least 12 % of the budget from industry.

FPEE has many strengths in the fields of power, electrical and environment engineering and has managed to establish a good reputation in the Baltic area with a reputation in the EU and

further afield, as witnessed by its foreign collaborations. It also has established a number of start-ups to exploit its research commercially plus helped with national strategy. It is thus making a solid contribution in the field in several important areas and has the potential to improve its performance.

However, there are several threats to this potential, the age profile of the staff, the lack of interaction of the staff internationally – language being given a problem, the wide range of research topics and the decreasing number of Masters and Doctoral students. Given the number of personnel, the Faculty covers too large range of research areas in order to reach the level of a strong international player. With streamlining i.e. narrowing both the research areas as well as the related organization structure, improvement is possible.

Potential to offer doctoral studies

The Faculty has presented a well thought out research strategy which builds on recent progress. It sets out clear objectives and norms across all relevant areas and portrays an entity which knows what it wants to achieve and how to achieve it. Its potential to further provide quality doctoral studies is high.

Alignment with Smart Specialisation Strategy

The Faculty contributes to the achievement of the objectives and development of the priorities in three out of five RIS3 thematic areas (Smart materials, technology and engineering systems, Smart Energy and Knowledge intensive bioeconomy). All three institutes were involved in the National Research Programme "LATENERGI".

Conformity with state scientific and technology development

FPEE is well aligned with state scientific and technology development in the energy sector in particular and contributing to its development.

Recommendations

FPEE has well defined research goals with clear monitoring indicators: 30 K euro funding per FTE, at least 4 paper per FTE in appropriate databases,10 doctoral thesis per 100 bachelor students, increase EU funding ratio of 30%. These indicators are not currently being applied. These are realistic targets for staff who are operating at the international level and should be applied. A detailed plan on how to achieve such targets needs to be developed and agreed within FPEE and implemented as soon as possible.

Over the assessment period the number of master's students has been decreasing which is a worrying trend and should be addressed.

For PhD studies, 139 doctoral students were enrolled over the period with a completion rate of roughly 50 %. Again, a worrying trend which needs to be addressed, e.g. via increasing the financial support to PhD students, so that they could focus full time on their research.

The Faculty has had success in projects in Europe and locally and has made good improvements since the last review however, given the main thrust of the Faculty's activities, its staff size and track record there is potential for the Faculty to improve its performance in prestigious publications, projects and technology transfer. It is recommended that the Faculty could improve its scientific impact by targeting more prestigious journals for publication venues and exploiting its contacts outside Latvia to enhance its profile and develop more international projects.

On economic impact the Faculty is performing well with a good supply of graduates into the workforce and through its spin off companies related to its research activities. It is recommended that this activity be increased and expanded given the good base which has been established.

On social impact the Faculty is having a good impact through production of graduate students who are benefiting Latvian society. Some of their research outputs have had an impact on societal well-being. There is further scope in this area. More communication of their research activities and benefits to the general public could help stimulate more societal interest and help address the student number decline (see above).

There is a concern about the wide range of topics being pursued which can impede the Faculty from being a strong international player. It is recommended that consideration is given to a large range of topics and to streamline where possible. For example, the energy area of power systems control and optimisation has produced results and external collaboration plus contributing to Latvian economy and has therefore potential for further development.

The FPEE, FET and FCSIT have some common R&D interests, and collaboration and sharing of resources among them is recommended to capitalize on potential synergies.

E_12 Institute of Electronics and Computer Science

Institution data

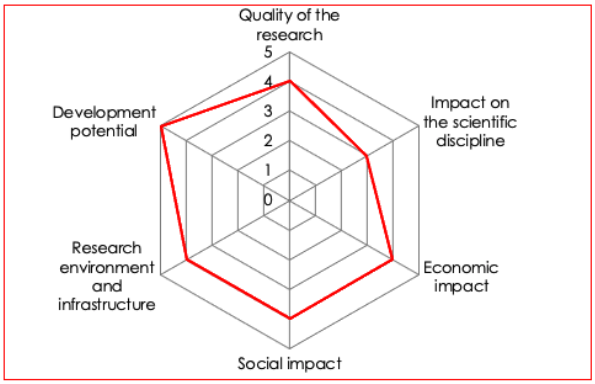
Institute of Electronics and Computer Science	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering
No. FTE academic personnel 2018	-
No. FTE academic research personnel 2018	37.7
Total number of FTE academic and research personnel 2018	37.7
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	122
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	36
Monographs	-
Patents Latvian	39
Patents (Europe and international)	25
Total no. of self-reported outputs	222
No. of WoS or Scopus outputs per researcher	3.24
No. of all outputs per researcher	5.89
No of PhDs completed 2013-2018	11
No. of PhDs per researcher	0.29
Total funding 2013 -2018 (Euros)	8,769,499
Total funding per researcher (Euros)	232,613

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 12 Institute of Electronics and Computer Science – Scores

Criteria	Scores
Quality of the research	4
Impact on the scientific discipline	3
Economic impact	4
Social impact	4
Research environment and infrastructure	4
Development potential	5
OVERALL SCORE	**4**



Overall score

Score: 4 – very good level of research

The Institute of Electronics and Computer Science (EDI) offers a clear definition of its research areas, supported by a set of research directions and laboratories with an adequate research vision. The strategy proposed by the unit is highly appropriate, as well as the selection of topics in the technological landscape of Latvia. The five main research directions (Signal processing, Event timing, Remote sensing, Machine perception, Smart sensors and IoT), and laboratories (DSP, Robotics, SpaceTech, CPS) are clearly important and well-chosen. The productivity of the Institute is very good relative to its size. Due to the current relevance of its research topics, it is expected that the institute will grow in size. Such growth is also expected to increase the institute's productivity, due to synergetic effects within the unit.

Quality of Research
Score: 4 – very good

The EDI research activities are directly oriented towards the strategic goal of Latvian Science, Technology and Innovation policy: "to develop Latvia's science, technology and innovation sector as a globally competitive sector that ensures the development of the Latvian economy and society" – contributing to the R&D of the Smart Embedded Cooperative Systems (SECS). The main application areas of the nationally and internationally oriented research portfolio of the EDI are: space, mobility, production, health, digital life. Due to the limited human resources the institute's main focus is on the development of a subset of enabling technologies for more ambitious projects, such as self-driving cars, satellite ranging systems, AI (performing the research at TRL1-6 levels), etc. Almost all technologies that are commercialised were developed based on their signal processing and imaging methods. The research programme contains a shared dissemination plan which includes knowledge analysis, internal and external exchange of knowledge, development of competences in the mentioned research topics, etc.

The average number of papers (full text publications) in peer reviewed scientific edited journals included in Web of Science or SCOPUS databases has been around 20 papers per year. This number is not very high, but the focus of the institute is towards applied research with real life important applications and active industrial collaborations. The papers have been published in good quality journals. The unit's performance is mainly visible via a very large number of EU level as well as industry collaboration projects. More than half of ICT H2020 projects granted to Latvian HEIs and research institutes were won by EDI. EDI has received the second highest funding per scientific staff FTE of H2020 projects in Latvia behind the Institute of Solid-State Physics. The research output by the institute achieves a very high standard of quality in terms of originality and importance. Work at this level can achieve serious interest in the international academic and industrial community.

Impact on the scientific discipline
Score: 3 - good

Despite a very intensive national and international collaboration the EDI has a relatively modest h-index for the main researchers. The EDI has developed an incentive program for publishing. The main focus is on the preparation of research proposals (for example, EU H2020 use-case demonstration-oriented projects during the assessment period), and technology transfer such as establishing patents, commercialization and utilization of software, etc. The focus of the research is on applied research and this can limit having also international high impact on the discipline, but overall, the institute occupies a stable position in the international scientific community.

Economic impact
Score: 4 – very good

The research portfolio of the EDI is well chosen and balanced in terms of the support of new economic sectors such as electromobility, Industry 4.0, robotics, green-energy transition, etc. Research of the institute is very important for the Latvian economy. The institute's interactions with the private sector stand out in terms of their extensive and dynamic involvement. The research output results have led to the establishing of two spin-offs and three start-up companies. An extensive collaboration with national and international research and industrial partners, like Infineon, Valeo, ESA, Roskosmos, etc. has been established. The efforts to increase international/national collaborations, enrol more BSc, MSc, PhD students (totally 139) has greatly increased the attractiveness of the EDI. The industrial partners confirm that the EDI plays

an important role in the academic-research-industry ecosystem, it is dynamic, fast in their responses and provides practical solutions towards the demands and challenges.

Social impact
Score: 4 – very good

The EDI collaborates with many public and private enterprises (around 300 companies, institutes, services).
The unit is actively involved in academic education - supervision of PhD, MSs, BSc students, internship training for national and international students, providing the research and laboratory facilities for students and giving courses at UL, RTU, RBS, TTI, VUC.
In particular, the institute is Involved in:

- national security (cybersecurity, collaboration with CERT);
- direct contracts with international and national companies (DATAMARS, DATI Group, Squalio, WeAreDots, Mondot etc.);
- active spin-offs: Eventech, Hackmotion, WeedBot;
- membership and cooperation in international and national industry associations (ARTEMIS-IA, LIKTA, LEtERA etc.) and clusters (IT, EEI, Space), etc.;
- participation in national and international exhibition.
- training of highly skilled professionals moving to industry (local and international).

EDI employees are invited to act as experts outside the academic research field, e.g. as H2020 and COST external experts, ARTEMIS and ECSEL Public Authority Board and Governing board member, foreign expert consultant in Wuxi district (China), member of the Advisory Board of the Technology Transfer Program, etc. as well as consulting for government ministries, taking part in different EU level and local working groups (GOVSATCOM, COPERNICUS, Space Policy Expert Group, System-on-a-Chip" under the As-If Programme Committee for Defense Research, EC Strategic Value Chain Industrial IoT working group, working group for development of automated driving in Latvia, etc.). EDI is also active in promoting science and actively engaged with the start-up scene in Latvia.

Research environment and infrastructure
Score: 4 – very good

The management of the research at the institute is well thought out and structured. The availability and quality of support services, research infrastructure, databases, technical staff, staff teaching and training workload, the ratio of students involved in research to the overall number of staff members is well balanced.
Most of the work is done in close collaboration with national and international industrial players in the field. This is also reflected in the very large number of industrial grants across a wide range of applications. However, this also creates a risk for the long-term strategic and resources planning. Firstly, the institute should ensure that sufficient funding is available for long-term fundamental research. Secondly, it also important that the unit remains strongly focused on its research strategy. The risk is that the activities become fragmented as a result of the budgetary and industrial pressure.
The research infrastructure is at a good level and internationally comparable and is well managed and sustained.

Development potential
Score: 5 - outstanding

The development potential is excellent due to the proper orientation towards topical issues in the selection of research themes and the institution has a potential to become global leader. The institution possesses abilities to achieve leadership in its discipline. It has already attracted

good researchers and PhD students who are very committed to their work and institute and has the right environment and policy to continue this and strive for best available talent.

The focus of research is internationally relevant and with a high potential to be interesting to international partners and the international scientific community in general. The institute already demonstrates good international collaboration in research projects and has a potential to further strengthen and grow this activity.

The main challenge in achieving this will be increasing the impact on the discipline which is doable if applied and fundamental research becomes more balanced.

Potential to offer doctoral studies

The research potential, the quality of the infrastructure, the capability of the scientific environment to support research and to offer doctoral studies is good. The Panel recommends the development of the doctoral training programme (i.e. develop all the training and support required for PhD students) or, perhaps, share a doctoral programme with an institute/university that already provides this) or consider developing a joint doctoral programme with other institutes.

Alignment with Smart Specialisation Strategy

EDI scientific activities are in strong alignment with Latvian RIS3 objectives to drive economic growth and transformation towards added value/more efficient economy through increased innovation capacity, thus providing social benefit. This is evidenced by participation in numerous industry innovation projects driven by research projects in H2020 Innovation actions, ESIF funded programs as well as direct contracts with industry.
EDI research in ICT and smart engineering systems (with significant horizontal impact) contributes directly to two RIS3 specialization areas related to fields of science represented by EDI:

- Information and communication technologies;
- Smart materials, technology and engineering systems.
- Additionally, EDI contributes to research with its partners from medical, agricultural and industrial clusters:
- Knowledge intensive bioeconomy - Sensor systems and automation of processes in agriculture, remote sensing of forests from satellite images etc.
- Biomedicine, medical technologies, bio-pharmacy and biotechnologies - wearable technologies and telemedicine, medical imaging, sensors and prediction algorithms, biofeedback.
- Smart energetics - Smart grids, energy efficient systems, power measurement.
- Contribution to the strategy is not only thematic, but also with quality research and increased value added to the industry.

Conformity with state scientific and technology development

The institute has made a significant effort in sustaining and improving research quality, it is internationally recognized and collaborates well with industry. It provides a very good research environment for young researchers. Thus, it has greatly contributed to the achievement of state scientific development objectives.

Recommendations

The Panel recommends that EDI should increase its output of conference papers and its participation in the main conferences in the relevant fields to enable the research teams to stay on top of the fast development of research and to provide sufficient exposure for researchers (in particular the PhD students, Postdocs, leading researchers).

The topics that are covered by the research teams support the areas that are relevant for society. Extensive collaboration with academic and industrial partners gives EDI a good understanding of the needs for knowledge in the industrial environment. Nonetheless, the external need for knowledge and expertise could be made explicit and documented to increase visibility.

The emphasis in the next 6 years on personal grants and TRL 1-2 funding is a necessary basis for higher TRL research and the number of scientific publications. Higher TRL research via research-direction teams is appropriate. The various research teams evidently strive for a combination of lower and higher TRL, but the Panel has the impression that most of the research is at higher TRL (levels 5-6). This is not considered a major problem as higher TRL research can be very creative and original, but sufficient attention and funds have to be devoted to more fundamental research as well, in particular so as to build a strong scientific knowledge position and cooperation with other interdisciplinary research groups. In the research projects which are devoted to the development of basic technology, a combination of fundamental and TRL 3-4 level research should attract more industrial contracts.

The Panel recommends that the institute sets concrete targets e.g. in publications, grants, conferences etc, as staff promotion criteria.

The institute is able to provide an internationally competitive, excellent research environment to high-level international scientists in the given discipline. Since the staff is mainly Latvian and has an unfavourable female/male ratio, the Panel recommends an international hiring scheme, where a much larger pool of potential top-level female candidates is available. Hiring internationally would also increase the overall international diversity of the EDI.

E_13 Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit

Institution data

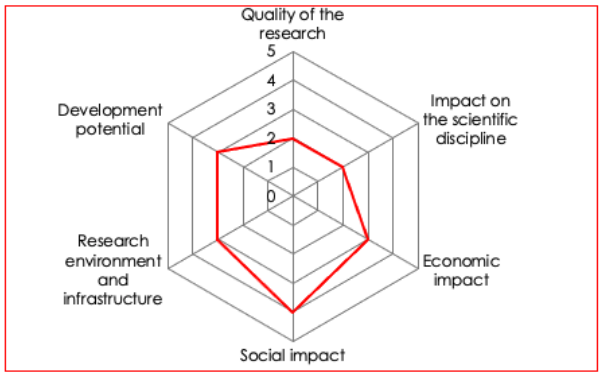
Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit	
Primary field of science	Engineering and Technology
Corresponding fields of science	Civil engineering, Electrical engineering, electronic engineering, information engineering, Mechanical engineering, Chemical engineering, Materials engineering, Environmental engineering, Industrial Biotechnology, Other engineering and technologies: Food and Beverage Technology
No. FTE academic personnel 2018	64.84
No. FTE academic research personnel 2018	42.55
Total number of FTE academic and research personnel 2018	107.39
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	861
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	676
Monographs in period 2013-2018	13
Patents Latvian in period 2013-2018	176
Patents (Europe and international) in period 2013-2018	18
Total no. of self-reported outputs in period 2013-2018	1,744
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	8.02
No. of all outputs in period 2013-2018 per researcher in 2018	16.24
No of PhDs completed 2013-2018	57
No. of PhDs in period 2013-2018 per researcher in 2018	0.53
Total funding 2013 -2018 (Euros)	11,521,455
Total funding in period 2013-2018 per researcher in 2018 (Euros)	107,286

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 13 Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit – Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	2
Economic impact	3
Social impact	4
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**3**



Overall score

Score: 3 – good level of research

The institution is a national provider of research on knowledge-intensive bioeconomy. Research objectives in the bioeconomy are related to research in the field of engineering, namely the use of more efficient primary products for the production of higher value-added products. The quality of the research as well as the impact on the scientific discipline are at reasonable level, and could be improved via focusing i.e. carefully selecting the research topics, and accordingly directing more resources to these selected research topics. The unit is an active collaborator with both private and public sectors. The unit's research contributes positively to the local food supply chain and development of higher value-added products. The unit is an important national educator, and graduates to its size adequate number of MS students and PhD students.

Quality of Research

Score: 2 - adequate

The Panel scored the quality of research with a 2, institution is a satisfactory national player. The average number of papers (full text publications) in peer reviewed scientific edited journals and conference proceedings included in the Web of Science or SCOPUS databases has been around 140 papers per year. When normalised by the total number of active academic and research personnel, we get about one paper per researcher per year. The papers have been published in the journals with the impact factor in the range 1 to 5, i.e. not in top impact factor journals. The leading scientists have H-indexes from 4 to 10, i.e. at a rather low level.

From the papers provided by the institution, it can be noticed that they are outcomes of collaboration with national and international partners. However, the papers are published with many co-authors (from 5-10 co-authors in each paper) and the authors from the institution are often neither the first nor the last author of these publications.

Around 60 PhD thesis have been defended, i.e. on the average around 10 per year. The number of academic persons (professors, associated professors and docents) normally tutoring PhD students has been reduced from close to 70 to 37 from 2013 to 2018. Accordingly, each of the above academic persons would have tutored on the average 1 to 2 graduated PhD students during the 6-year period, which is not high for the practical fields of the institution. To summarise, the institution is a satisfactory national player. The institution occupies a stable position in the national scientific community. The position of the institution within the international scientific community seems to be evolving. It has potential to strive for its status as a recognised member of the discipline and its impact on the international scientific community is being slowly built up.

Impact on the scientific discipline

Score: 2 - adequate

The Panel scored the impact on the scientific discipline with a 2 – a satisfactory national player. The main research directions are extremely broad as well as diverse, covering the following areas: research in wood materials and technologies, use of sustainable energy in vehicles, smart technologies and robots in biosystems, sources and use of renewable energy, reduction and rational use of by-products and residues, new products from raw materials of plant and animal origin, their nutritional studies, research of biologically active substances in raw materials of food and products, research of environmental and climate change reducing technologies, hydrology and agricultural runoff, remote sensing, geodesy and geospatial research, landscape architecture, sustainable civil engineering, development of new, innovative building materials, research of their properties, safety and performance of building structures with long-term load, systems biology, modelling and optimization of metabolic network, information technology solutions, application of mathematical modelling and statistics in agriculture, environmental and forestry sciences, development and evaluation of intercultural information systems.

It is not clear which of these would be the main focus areas. In other words, the efforts to a given research topic seem modest, and accordingly also the scientific impact is modest, as discussed based on the analysis when assessing the quality of the research performance above. Only a few invited talks were given by the unit's scientists at meetings outside Latvia. The unit joined a modest number of European research projects as a partner.

Economic impact

Score: 3 - good

The Panel scored the economic impact of the institution with a 3 indicating a good impact. The self-assessment presents the unit as an active collaboration with the private sector, i.e. 113 cooperation agreements have been concluded with companies of all sizes between 2013 and 2018, with private funding being involved. However, the funding from companies is low, i.e. below 200 000 € for 2013-18, in other words the projects with companies are rather small in size.

Technologies, elaborated for the industries, are considering relevant sustainability aspects, such as reuse of waste, reduction of energy consumption, increase of energy efficiency, etc. However, the research results have been patented with a total of 176 registered Latvian patents, and 18 are international i.e. registered European ones. The results of applied research especially in the following areas have been recognised nationally: 1. biologically active substances in foods, using the latest packaging technologies for packaging and storage, guaranteeing high quality and safe expiry, 2. scientifically based fibre-rich cereal flakes that have been successfully commercialized and registered and 3. new solutions for protein and fibre-rich food products from grey peas and broad beans grown in Latvia – pulse spreads, extruded-legume snacks and bars from legumes. Accordingly, these results would contribute positively to the local food supply chain and development of higher value-added products.

Social impact

Score: 4 – very good

The Panel scored the social impact of the institution with a 4 indicating very good impact. The unit graduates 421 MS students and 57 PhD students thus significantly contributing to the education of the young generation and providing well trained employees to companies.

The scientists are members of many Latvian committees relevant to the unit's research fields, including the Nutrition Council of the Ministry of Health of the Republic of Latvia, State Land Service Advisory Councils and Food and Veterinary Service (PVD). Thus, the results of the research can be used to improve policy.

The scientists of the institution are also very active in communicating research results to the general public through various channels.

Research environment and infrastructure

Score: 3 - good

The panel scored the research environment and infrastructure with a 3. Since 2015 the unit has been a member of the Latvian Academic Network (hereinafter referred to as LAN) which provides connection to Latvian scientific infrastructure network, services, scientific libraries, databases, and provides connection to institutions under unit's supervision. Within the framework of the LAN project, the unit has acquired high performance servers, disk arrays, network infrastructure equipment that provide high-capacity mathematical calculations (cloud computing, laser-data processing), data analysis and statistical processing, modelling processes. However, it is not clear what kind of modelling is done and what kind of data transfer this network is used for.

Recently several laboratories have been created and upgraded and the process is ongoing.

A virtual database of units researchers has been created, which collects and systematises publications, data obtained from research projects, abstracts of international conferences, popular scientific and other published information.

In summary, the research infrastructure is at a reasonably competitive level. However, the sustainability of the research infrastructure is somewhat questionable, due to the low number of experienced instrument operators. Another issue related to the research environment and human resources in particular is the teaching load which appears to be high thus leaving less time for research.

Development potential

Score: 3 - good

There exists significant development potential when strategically selecting carefully narrower research areas with active academic leaders and focusing more efforts. Now there are simply too many as well as diverse research topics. As the research is applied in nature, natural selection would be among those directions with many potentially economically important patent applications, which should then be utilized by the companies in Latvia, like e.g. the efficient use of agricultural raw materials and processing by-products, including chipless wood conversion technology.

Potential to offer doctoral studies

All doctoral students have supervisors, and other faculty members help when needed. Most of the studies are done independently and supervisors will be called upon for help when needed. Many students are also working in industry, so it is not the typical full-time experience, it is varied. The professional work is often related, the research is collaboratively developed with the university with the student as the key actor between them. Students have opportunities to give guest lectures. The unit has reasonable resources to offer doctoral studies.

Alignment with Smart Specialisation Strategy

The institution is a provider of knowledge-intensive bioeconomy and its activities significantly contribute to the RIS3 policy goals. Research objectives in the bioeconomy are related to research in the field of engineering, namely the use of more efficient primary products for the production of higher value-added products. To achieve the aim, researchers from engineering science in cooperation with other scientific institutions in Latvia deal with the efficient use of agricultural raw materials and processing by-products, including chipless wood conversion technology. Unit scientists participate in the operation of the Latvian Food Competence Centre and The Forestry Sector Competence Centre.

Conformity with state scientific and technology development

Research objectives in the bioeconomy are focusing on the use of more efficient primary products for the production of higher value-added products. This clearly contributes to the Latvian policy goals to increase the international competitiveness of the bioeconomy. To achieve the aim, the unit - in cooperation with other scientific institutions in Latvia - deal with the efficient use of agricultural raw materials and processing by-products, including chipless wood conversion technology within the framework of the national research programme. Doctoral students and young scientists are involved in project development, gradually creating a new generation of engineering scientists.

Recommendations

The research topics of the unit are rather broad as well as diverse. It is recommended to select fewer topics and accordingly have larger resources in these topics. This would lead to higher impact factor scientific publications as well as innovations with larger commercial potential.

A full tenure track system is recommended for the faculty selection and improvement.

It is recommended that students should work for their doctoral research full time, i.e. without the need to work in a company. That would allow their studies to reach a higher scientific level.

More funding for fundamental research should be included, which can enhance understanding in the overall research effort and the reputation of the institution and contribute to the field of science.

The support of Master and PhD students via a number of services such as a career office, office of innovation and entrepreneurship, training and rewarding of excellence to promote visibility and encourage opportunities to build on existing areas of strength should be enhanced.

Organization of internal seminars for researchers and PhD students to improve research quality and impact of the institution into industry should be planned.

The employment of international researchers, the development of doctoral and interdisciplinary post graduate programs, training of new researchers, the involvement of Bachelors and Master students in R&I projects, the establishment of a formal program for industrial internships to provide an opportunity for students to receive experience in engineering practice could be boosted.

The establishment of a Research Committee is recommended to enhance cross-section communication and identify the potential of existing and/or new resources.

Periodic seminars about intellectual property should be organised to be better prepared for collaboration with industry.

Although a development strategy exists, the long-term strategic and financial resource planning, including the human resource development strategy is not very solid. For example, more assistance to the research staff in preparing international research proposals as well as preparing high quality papers should be considered. Decrease teaching duties of strong researchers to allow better focus on the research tasks. Consider providing short-term (e.g. one month) leave to prepare applications for international grants.

Invitations for keynote, invited professorships and mobility should be enhanced.

The staff recruitment process that results in in-breeding is internationally considered adverse to scientific progress and may inhibit cross-fertilization and introduction of new ideas and techniques that lead to competitive scientific practices. This should be avoided, and the institution should strive to be open to international students and staff.

To summarise, very important would be to select fewer research topics, introduce a full tenure track system and offer students the possibility to work for their doctoral research full time.

E_14 Liepaja University, Engineering and Technologies Unit

Institution data

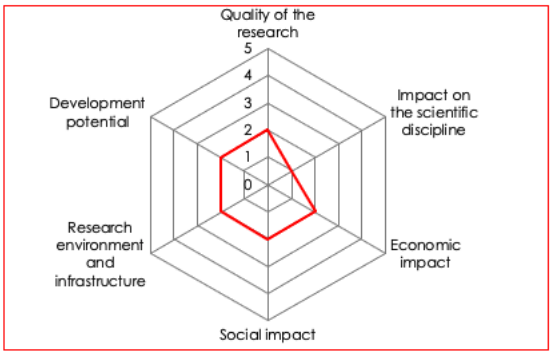
Liepaja University, Engineering and Technologies Unit	
Primary field of science	Engineering and Technology
Corresponding fields of science	Electrical engineering, electronic engineering, information engineering, Materials engineering, Environmental engineering, Environmental biotechnology, Industrial Biotechnology, Nano-technology
No. FTE academic personnel 2018	19.04
No. FTE academic research personnel 2018	7.23
Total number of FTE academic and research personnel 2018	26.27
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	84
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	81
Monographs in period 2013-2018	7
Patents Latvian in period 2013-2018	4
Patents (Europe and international) in period 2013-2018	4
Total no. of self-reported outputs in period 2013-2018	180
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	3.2
No. of all outputs in period 2013-2018 per researcher in 2018	6.85
No of PhDs completed 2013-2018	3
No. of PhDs in period 2013-2018 per researcher in 2018	0.11
Total funding 2013 -2018 (Euros)	1,025,050
Total funding in period 2013-2018 per researcher in 2018 (Euros)	39,020

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 14 Liepaja University, Engineering and Technologies Unit – Scores

Criteria	Scores
Quality of the research	2
Impact on the scientific discipline	1
Economic impact	2
Social impact	2
Research environment and infrastructure	2
Development potential	2
OVERALL SCORE	**2**



Overall score

Score: 2 – adequate level of research

Liepaja University's Engineering and Technology (LiepU ET) has a very broad research programme. The management should encourage group leaders to take more leadership roles in their fields, including developing a strategy for higher impact publications since at the moment publication focus is mainly national. Overall, it is necessary to increase the "added value" of the research to ensure a stronger impact. A periodic assessment of researchers should be made with subsequent rewards. A doctoral study programme related to the main research lines proposed by the institution that uses its experimental possibilities should be implemented.

Quality of Research

Score: 2 - adequate

LiepU ET has a very broad research programme. The institution started the present lines of research in 2015. The coherence of the new research lines is questionable, and this is probably the result of the past activities and of the current expertise of the institution's research personnel. There are too many research directions, driven by divergent individual interests. Research is thematically focused on biotechnology, transforming wave energy in shallow waters, transforming energy of relatively low waves in conditions with no tide. E-learning is also being pursued. Results are published mainly in Latvian journals and at regional conferences. No research project related to EC Framework Programmes is presented for the period 2013-2018. The R&D described involved no significant novelty. Based on the information provided in the self-assessment and during the visit, the institution is at best a national player.

Impact on the scientific discipline

Score: 1 - poor

Impact on the scientific discipline is severely limited by the low publication output. The data presented on outputs over a six-year period are too low for research which could be described as excellent in quantity and quality. The institution focused from 2015 onwards on the following research lines: Innovative engineering, Energy systems and materials, Information and communication technologies, Research and sustainable use of local resources, Circular economy and Innovative techniques in education, preferably STEM subjects in high school. Potentially, all of these could have impact in their respective fields of science. Although the institution mentions work done in energy systems and materials and on coastal habitats in the Kurzeme region, no publications on these subjects are reported.

Economic impact

Score: 2 - adequate

Potentially, the research subjects selected by the institution can have economic impact on the Latvian economy, but that remains to be demonstrated. The only visible impact is provision of some graduates for local industry, but that is not related to the research work. The present economic impact of research is very low.

Social impact

Score: 2 - adequate

In principle research at the institution is important for society. Liepaja University is not only the largest higher education institution in the Kurzeme region but also a major player in the creation of qualified jobs and in providing the skilled workforce in the region. The main IT companies have their offices in Liepaja because of the supply of qualified students. International students contribute to the cultural impact of the University in the region.

The institution promotes culture, higher education, social equality, integration, and welfare, and understanding of the significance of scientific activity. However, the social impact does not go beyond some popularization of science. There are no common research projects, no co-funding from partners and limited research contribution to the problems faced by public/society institutions. Thus, institution's interactions with the public sector/the public are limited and at a low level.

Research environment and infrastructure

Score: 2 - adequate

In terms of research infrastructure, the institution has a set of laboratory equipment to support R&D in the different research lines. This research environment is mainly oriented to thin film technology (CVD, sputtering), scanning electron microscopy, solar energy devices and biotechnology. Detailed descriptions of infrastructure devices are not provided, but it seems that the infrastructure is insufficient for the broad spectrum of research areas presented.

In terms of research environment, the funding and human resources seem too low for the planned R&D activities. The institution failed to present a convincing strategy for improving the quality of research outputs and increasing internationalization. It seems that in some cases teaching load is too high and PhD students also lack time to focus entirely on their research projects. Research environment is still evolving to become comparable to international standards.

There is no evidence that the present infrastructure is used for education and training of PhD students. E-learning is presented as the only one thematically focused on PhD studies.

Development potential

Score: 2 - adequate

The institution chose some lines of R&D which have a large environmental, economic and social impact. The institution mentions some non-published results that support this claim. However, it is not clear that the institution's environment is capable of supporting the chosen research. The institution's SWOT analysis backs this concern by pointing out weaknesses and threats mainly related to difficulties in funding and in qualified human resources, both aggravated by the peripheral location of the institution relative to the capital, Riga. In addition, a recent wide research programme indicates that the role of management is not sufficiently effective. To rectify this weakness, it is necessary to publish scientific results in the English language and in journals registered in recognized

international databases (WOS, Scopus). Management should encourage group leaders to take more leadership responsibilities in their fields, including developing strategy for higher impact publications. Overall a big increase of the "added value" of the research is necessary to ensure stronger impact and tackle more challenging problems of current interest to gain better international visibility. The institution has the potential to become a strong national player if the above is addressed.

Potential to offer doctoral studies

The faculty is responsible for the doctoral study program "E-learning technologies and management". It is a joint program with Riga Technical University. This doctoral program is the only one of its kind in Latvia. The program is expected to be updated and developed as a joint programme of 4 universities.

The Doctoral program "Research and Modelling of E-Ecosystems" is focused on solving problems identified by the European Commission: open educational resources (OER) and analytical data about studies can improve learning, but they are still not sufficiently used.

The institution seems very committed to doctoral studies. Recently a PhD study has been offered with a thematic focus only on E-learning. However, the infrastructure, laboratory equipment together with LiepU ET's position on the Baltic seacoast offer much broader potential for PhD studies.

Alignment with Smart Specialisation Strategy

The university's research is partially oriented to biotechnology, transforming wave energy in shallow waters, transforming energy of relatively low waves and in conditions with no tide. This focus is related to the RIS3 areas Knowledge-intensive bio-economics and Smart energy. However, the contribution to the strategy is somewhat limited due to rather low quality of research, poor internationalization and interaction with industry.

Conformity with state scientific and technology development

Based on data provided in the self-assessment material, the scientific activities and goals are relevant to national policy as presented in key policy planning documents. However, the actual contribution to the achievement of these goals is limited due to limited quality of the research performed at this institution.

Recommendations

The University needs to address the following:

- Research directions are very broad and limit focusing on internationally significant research subjects and themes. It is recommended to narrow the research areas and focus on few that have the highest potential and build strong teams around those areas.
- Management should encourage group leaders to take more leadership responsibilities in their fields, including strategy for higher impact publications. Overall increasing the "added value" of the research is necessary to make a stronger impact and tackle more challenging problems of current interest to gain better visibility internationally.
- The impact of the institution's research, development and innovation activities should be increased by publication in internationally respected journals, patent registrations, and participation in both national and international projects.
- The institution should focus on promoting international visits by leading researchers to improve personal contacts with the aim to find possibilities for new international projects and consortia. This policy should be applied for both inward and outward visits.
- Senior researchers should be able to dedicate if not full time, at least a significant percentage of their time to R&D activities and not be overloaded with other

academic activities or involved in external private or public activities.

- A periodic assessment of researchers should be made, and consequences drawn. The assessment should focus on and incentivise presentation/publishing research results in English language and in WoS high ranked indexed journals.
- A doctoral study programme focusing on the main research areas proposed by the institution and using its experimental facilities should be implemented.

E_15 Riga Technical University, Faculty of Computer Science and Information Technology

Institution data

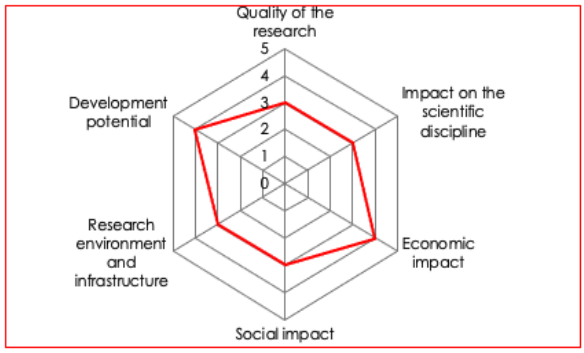
Riga Technical University, Faculty of Computer Science and Information Technology	
Primary field of science	Engineering and Technology
Corresponding fields of science	Computer and information sciences Electrical engineering, electronic engineering, information engineering
No. FTE academic personnel 2018	42.93
No. FTE academic research personnel 2018	29.67
Total number of FTE academic and research personnel 2018	72.6
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	519
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	565
Monographs in period 2013-2018	20
Patents Latvian in period 2013-2018	3
Patents (Europe and international) in period 2013-2018	1
Total no. of self-reported outputs in period 2013-2018	1,108
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	7.15
No. of all outputs in period 2013-2018 per researcher in 2018	15.26
No of PhDs completed 2013-2018	24
No. of PhDs in period 2013-2018 per researcher in 2018	0.33
Total funding 2013 -2018 (Euros)	6,186,327
Total funding in period 2013-2018 per researcher in 2018 (Euros)	85,211

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 15 Riga Technical University, Faculty of Computer Science and Information Technology – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	4
Social impact	3
Research environment and infrastructure	3
Development potential	4
OVERALL SCORE	**4**



Overall score

Score: 4 – very good level of research

The Faculty of Computer Science and Information Technology (FCSIT) is the largest ICT entity in Latvia. It has a well-defined and well-focused set of ICT research topics and a set of priorities which is focused on the country's and the EU research and development strategies. Since the last assessment it has consolidated several research departments and reduced fragmentation.

The annual publication rate has grown by ~25% over the assessment period and the publications appear in better publication venues. Cooperation and collaboration with industry has increased, and there has been increased participation in EU projects. The staffing and doctoral programme have been further developed over the assessment period with plans for further enhancement.

Overall FCSIT is a strong national player with international impact and has potential for further development. The main focus of the Faculty is on industrial and contract research of high national importance. This focus limits the international impact on the scientific discipline. The panel encourages the Faculty to consider high-risk, high-gain projects that may not be of immediate industrial interest but can increase the amount of high-quality basic research.

Quality of Research

Score: 3 - good

The Faculty organizes its research into four groups. (i) Massive Computational Intelligence for Evolutionary Digital Enterprises, focused mainly on business IT; (ii) Ambient Intelligence for Smart and Autonomous Systems and their Integration, which includes AI and robotics, but also subjects such as software engineering and databases; (iii) Pervasive Data Processing in Distributed Complex Environments, addressing issues such as image processing, sensors, networks, and medical applications; (iv) Mathematical Modelling, covering fluid mechanics and non-destructive testing.

These research directions have been set by the Faculty based on the research priorities defined by the EU and the Latvian Science, Technology Development and Innovation Guidelines 2014–2020. In this way the Faculty plans to engage in internationally relevant research as well as to ensure that Latvia benefits from ICT research innovations. In practice, the emphasis is on applied research, and there is also a large focus on contract R&D.

Applied projects highlighted in the report as being of "relatively high visibility" are simulation of the public transportation system, autonomous and mobile robots, image

processing methods for visible and thermal sensors, and big data processing methods. All projects are likely to be of high relevance for the project partners, but their significance and originality as research contributions in an international context is not clear. The publications related to these projects appear in venues that are listed in international databases, but mostly not in the high-ranked conferences and top-tier journals. An exception is a publication, addressing performance metrics for unmanned systems, which is published in a highly-ranked conference (IROS).

The small amount of fundamental research in the Faculty is carried out in automated code generation and systems modelling and mathematics. It is interesting to note that the publication that is really in a top-tier journal covering fundamental research, Physics of Fluids, concerns an important subject but not one that is usually associated with an IT institution.

In order to promote research, the Faculty signs an annual research agreement with the university which specifies key performance indicators, such as the amount of funding to be attracted, number and type of articles to be published etc. This approach has likely been instrumental in the reorientation of the Faculty that has taken place during the reporting period. The agreement also includes students' development as well as public relations activities.

Since the last assessment, the Faculty has consolidated several research departments. One of the main recommendations from the last review was to address the fragmentation of research directions and departments. This has been addressed and FCSIT now contains the activities of five previous entities with a new strategy and updated research activities. Already the benefits of the merger are reflected in increased and better publications, better age profile, more funding etc., although the total active academic and research personnel show a 10 % decline over the assessment period.

The Faculty also has a strategy for external promotion based on sustainable innovations and commercialisation of its activities.

Impact on the scientific discipline

Score: 3 - good

There are several scientific disciplines involved, given that the assessment unit is a Faculty. There is no definitive description in the self-evaluation report of the specific impact of the research internationally or highlighting of particular contributions that have had an international impact; most of the description of the research is given in general terms. The strong focus on applied subjects and contract research can be difficult to combine with an internationally high impact on the scientific discipline. Contract research aims at solving practical problems, the partner typically prefers the use of well-established techniques instead of untested cutting-edge research technologies, and publications are rarely deemed as essential and may not be possible due to NDA.

Of the publications, 25% were in collaboration with researchers outside Latvia. The annual publication rate has grown by 25% over the assessment period. In addition, there has been a quality increase as measured by publication venues; the journal outputs in recognised databases show a doubling of publications from 2013 to 2018. However, the number of publication venues listed in such databases has also increased during the reporting period, and there are differences in quality and impact among the listed venues. Of the most important publications specified in the self-assessment, very few are in high-ranked conferences or top-tier journals, and the publications have only received a modest number of citations.

The Faculty is active in several EU projects, but it is not clear whether they are the project leaders. There are a number of collaborations within Latvia and the Baltic states both academic and commercial; the number of collaborations outside this region is modest.

There is a wide range of visits to other institutions abroad and participation in conferences which is in line with the number of personnel involved.

Economic impact

Score: 4 – very good

FCSIT presents a strong case for its impact on the Latvian economy. The Faculty has the largest student body in ICT subjects of the universities in Latvia, and it is crucial to meet the staffing needs of industry. Staff and students are directly involved in running over 100 ICT companies. Therefore, the Faculty can rightly claim to be a major player in the Latvian ICT sector. This impact is further supported by a substantial increase in research funded projects with industry, having risen from 10 K euro in 2013 to 160 K euro in 2018. Many of the projects are in line with the national strategy. There is a low number of patents over the assessment period.

Social impact

Score: 3 - good

Together with industry (Accenture, LMT, Lattelecom) and professional associations (Letera, LIKTA, ICT-Cluster), FCIT has been active in societal communication activities, in order to increase the interest in ICT and engineering education. These efforts seem also to have been successful as the number of students applying for the educational programs at the Faculty has increased, in spite of a negative demographic trend. Staff at the Faculty is reported to have been involved in public science communication activities on average about 15 times per year during the evaluation period.

J. Grundspenkis is a recognized AI expert in Latvia, active in TV and radio. A number of other individuals contribute to important activities of a social outreach character. Outreach is very relevant, but other dimensions of social impact are not that outstanding.

Research environment and infrastructure

Score: 3 - good

FCIT has successfully been able to streamline and reorganize the activities of the Faculty during the evaluation period, based on the outcome of the previous evaluation as well as to follow European and national priorities. The Faculty has succeeded in bringing in new young staff during the evaluation period, to increase international cooperation and cooperation with industry, and to access new sources of funding. All these results indicate the presence of an effective management structure. Further effort is needed to attract PhD students, provide quality education and full time for research as well as ensure postdoctoral career development opportunities in the faculty.

The main physical infrastructure facility of national significance is the Information, Communication and Signal Processing Technologies Research Centre, which provides equipment for the range of research being pursued by the Faculty. Most of the infrastructure is open access. A fraction of all external income is allocated for maintenance and upgrade of the equipment — a good policy to ensure continuous upgrade of the infrastructure.

Development potential

Score: 4 – very good

The Faculty has presented a well thought out research strategy that builds on recent progress. The performance has improved in many areas during the evaluation period, and the self-evaluation report provides statistics that support the improved performance. For the next 6 years, the strategy outlined uses essentially the same objectives as the ones adopted during the current evaluation period but with higher ambitions.

The development plan aims, in particular, at

- improvements with respect to a wider and tighter cooperation partner base,
- higher involvement in H2020 (becoming Horizon Europe) by taking on project coordinator roles,
- a more intensified publication rate in high-quality venues and higher citation rates,
- intensified technology transfers and commercialization processes,
- improved development and participation of the research infrastructure.

The strategy sets out clear objectives and norms across all relevant areas and portrays an entity that knows what it wants to achieve and how to achieve it. As a result, the panel rates the potential of FCIT as high and it has a potential to become a strong international player. However, the strategy chosen by the Faculty is not without its risks. The intense focus on contract research and innovation activities (note that most Horizon 2020/Europe projects are more innovation- than research-oriented!) means that the strategy is unlikely to result in a high impact on the international research stage and is unlikely to contribute to cutting-edge technology development.

In order to be able to carry out research on a high international level, a few additional factors are necessary to consider. First, the need for long-term, high-risk, high-gain fundamental research must be recognized by the government, the university, and the Faculty since industry is unlikely to fund such activities. Secondly, the young staff should have post-graduate experience in the best research environments in the world. It would be strategically beneficial to adopt similar rules as in other Western countries and make it a necessary requirement for appointment of permanent research staff, for instance professors, to have completed international postdocs. Such a policy is of particular significance in a small country such as Latvia, where a large portion of the recruitment is internal, from the institution's own PhD students. Third, access to funding for high-risk, high-gain fundamental topics is crucial for high-impact research to be possible. On the European level, such funding is available through the European Research Council and through the FET programmes. It is also important that local funding for high-risk, high-gain research is made available, not least to foster Latvian researchers to be able to compete for the ERC and FET grants.

Potential to offer doctoral studies

The number of young researchers shows a slight decline since the last assessment period although there are plans to increase the PhD numbers.

The PhD programme has three main themes: Applied Computer Systems, Information Technology and Automation, and Computer Engineering. The Faculty is moving towards a full cost model for PhD students, that is, the students are being paid to enable full time involvement. This is a commendable strategy that should improve the uptake in the doctoral programme. The Faculty believes this move is necessary to improve the long-term viability of the research programmes and to address the age profile situation. It seems that the full-cost programme is mostly aimed at industrial PhD students. A similar competitive programme should be made available for non-industrial high-risk, high-gain projects in order to be able to attract well-qualified individuals to such programmes.

Post-doctoral training is through on-going research work. Only about 20–30 % of doctoral students remain in academia, hence society is benefiting more than the university. There has been success in obtaining three ERDF post doc positions.

There is a good personnel development strategy with the main themes being to increase the number of students, expand the doctoral programme, and ensure faster promotion of young researchers. All factors which are essential for the future.

Alignment with Smart Specialisation Strategy

As Latvia's largest educator of engineers for the ICT sector, FCSIT aligns in a crucial way to the ICT knowledge specialization area. However, since ICT permeates virtually all sectors of industry and society, the Faculty has in fact a broader alignment. In particular, the activities within the Faculty align with the areas *smart materials, technologies and engineering systems,* and *biomedicine, medical technologies, bio-pharmacy and biotechnologies.*

Conformity with state scientific and technology development

The FCSIT has during the evaluation period made a concerted effort to restructure its activities according to the research priorities defined by the European Commission and the Latvian Science and Technology Development and Innovation Guidelines 2014–2020. In particular, the research aligns with the policy objective *Smart Growth: developing an economy based on knowledge and innovation*. FCSIT is the one the assessed Units that explicitly reports on its restructuring to comply with these policy goals.

Regarding human resources, the Faculty has succeeded to bring in new young staff during the evaluation period and to lower the average age, which is an impressive accomplishment by the Faculty, considering the high competition from the private sector for personnel in the IT sector.

The Faculty has substantially increased its collaboration with industry, both in terms of common projects and as a contract research partner. The growth in monetary terms has been from about 10 K€ in 2009 to about 160 K€ in 2018. FCSIT has a deliberate policy of supporting the creation of spin offs and collaboration and cooperation with industry – it is emphasised in their strategy and expected of their researchers. They have utilised appropriate transfer centres for business and innovation and utilise the University's student business incubator.

Internationalization has progressed in two ways. First, there has been a shift towards publications in venues that are recognized in well-established databases, even though the presence in the highest-impact journals and conferences are still to be developed. Secondly, the Faculty has an increased presence in EU-funded projects, in ERDF as well as Horizon 2020 projects.

Recommendations

The research development plan outlined in the self-evaluation report is an excellent starting point for the next 6 years, and it will, if followed through, go a long way to further improve the Faculty, particularly with respect to its impact on society, the IT-related industry, training of personnel, and innovation and commercialization.

However, in order to further improve the quality of the research on an international level, the Panel believes that there is a need for additional actions not described in the self-evaluation report. It is recommended

- Make it a requirement, or at least a strong suggestion, for obtaining a permanent research position in the Faculty to have completed an international postdoc or research position.
- Encourage and fund selected research projects of a fundamental nature aiming at high-risk, high-gain problems. A rigorous screening is necessary in order to promote the most promising projects, the most capable scientists, and the most promising students.
- For publications, aim for the highest-ranked conferences and for high-impact journals. Being listed in Scopus or WoS databases is, in these days, not a rigorous enough criterion for quality.

- The FCSIT, FET and FPEE have some common R&D interests, and collaboration and sharing of resources among them is recommended to capitalize on potential synergies.

E_16 University of Latvia, Institute of Mathematics and Computer Science

Institution data

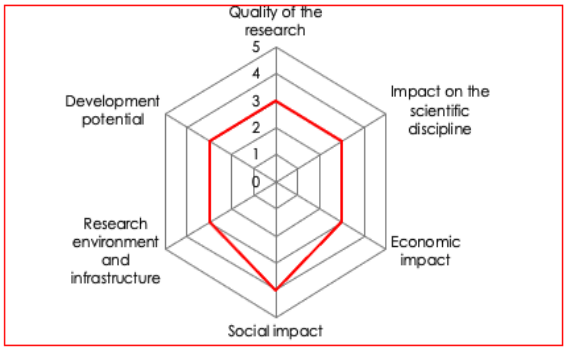
University of Latvia, Institute of Mathematics and Computer Science	
Primary field of science	Engineering and Technology
Corresponding fields of science	Mathematics Computer and information sciences Electrical engineering, electronic engineering, information engineering Languages and literature
No. FTE academic personnel 2018	-
No. FTE academic research personnel 2018	43.38
Total number of FTE academic and research personnel 2018	43.38
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	322
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	100
Monographs in period 2013-2018	5
Patents Latvian in period 2013-2018	4
Patents (Europe and international) in period 2013-2018	1
Total no. of self-reported outputs in period 2013-2018	432
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	2.64
No. of all outputs in period 2013-2018 per researcher in 2018	3.54
No of PhDs completed 2013-2018	13
No. of PhDs in period 2013-2018 per researcher in 2018	0.11
Total funding 2013 -2018 (Euros)	16,741,363
Total funding in period 2013-2018 per researcher in 2018 (Euros)	385,924

Expert panel evaluation

The figure below presents the scores assigned by the Expert Panel to the institution.

Figure 16 University of Latvia, Institute of Mathematics and Computer Science – Scores

Criteria	Scores
Quality of the research	3
Impact on the scientific discipline	3
Economic impact	3
Social impact	4
Research environment and infrastructure	3
Development potential	3
OVERALL SCORE	**3**



Overall score

Score: 3 – good level of research

The Institute of Mathematics and Computer Science (IMCS) engages in research activities as well providing service functions. It provides the computing infrastructure for the University as well as providing essential services nationally, for example, in cybersecurity. The range of research topics being pursued is wide and could benefit from streamlining and more focusing if a high international level is to be achieved.

There is good interaction with non-academic institutions through local projects and the social impact is high through its service functions and activities in the promotion of the Latvian language.

The infrastructure is modern with a new building in 2019 and a wide range of equipment to facilitate research.

The research and service activities do not appear to be bringing benefits in promoting international research and could be separated into their own structures to realise their full potential.

Overall, the institute is a strong national player with some internationally recognised activities.

Quality of Research

Score: 3 - good

The two main research themes of the institute are Mathematics and Computer Science. Each theme has a wide and varied range of topics, in Computer Science it ranges from linguistics to bioinformatics, for Mathematics the topics are less and more focused. The research landscape is therefore somewhat fragmented.

In addition to conducting research, the institute also operates as an IT service provider; the possible benefits of this mixture are not obvious. Most of the work listed as Innovative Application-Oriented Services in the self-evaluation report is not really research.

There does not seem to be a substantial overlap between the two research themes and there was little evidence of mutual benefit, collaboration, or interaction. It is not clear what the research mandate is for joining these research themes in this Institute. It does state that the institutes' research synergy is sustained by a shared understanding of Mathematics and Computer Science, but it is not detailed or justified in the research topic reports.

For each of the topics a brief description is given of its success or its impact. For example, for knowledge engineering, semantic and visual modelling tools have been developed

and presented at conferences and published in journals. There has been no international competitive research funding success although an ERDF project has recently started.

For machine learning, the successes are modest; its researchers are participating in an EU H2020 project. The bioinformatics research has high international visibility, as the institute is a highly regarded co-operator with the European Bioinformatics Institute, and researchers from the institute are co-authors on publications in high-impact journals such as Nature.

The real-time and autonomous systems group carries out some high-quality applied and industrial research. The group has been active in EU framework programmes within the environmental area. Also, worth mentioning is the long-term R&D contracts with Telos Alliance (USA) in the area of audio networks and streaming.

Mathematical modelling has been applied to energy efficiency in conjunction with the University's Physics Department with promising results. There is no mention of publications nor grant funding. The work on dynamic systems theory and many valued mathematical structures does not mention successful publications or grant funding.

Of particular importance is the language-technology work focused on the Latvian language, combining knowledge-based and machine learning approaches. The work is of obvious national concern, it is of high quality, carried out at a good international level, with participation in a H2020 project, with industrial partners, and the work is also reported in top-tier scientific publications.

The work on computer security has national significance and applied locally but low impact on the international scientific arena.

The institute is the centre for linking to Geant and manages the country's code domain. However, these are service functions and do not list any research successes.

Computing is within the priorities of the Latvian government's research strategy and the institute has been active in submitting grant applications locally and to the EU programmes, which is to be commended.

Although many of the topics are relevant to and appropriate for a major research institute, there is a major concern about the staff age profile and the admitted lower-than-expected performance of some research groups. In addition, the lack of a PhD programme and the lack of available students is worrying for the long-term future of the Institute - studying abroad and higher industry salaries are mentioned as factors but not unique to the institute.

Given the wide range of topics it is difficult to identify an appropriate single scientific competitor, as a result the institute will not compare favourably in the topics as it is competing with international focussed topic institutes. Many of the competitor organisations listed are not collaborating with IMCS.

Impact on the scientific discipline

Score: 3 - good

The institute has made a concerted effort to increase the number of publications that are indexed in international scientific databases. This effort has been successful. However, the number of publication venues listed in such databases has also increased during the reporting period, and there are huge differences in quality and impact between the listed venues. Some of the work carried out by the institute has been able to gain visibility in high-ranked conferences and top-tier journals. In particular, the areas of knowledge engineering, natural language processing, bioinformatics, and (in what they call) many-valued mathematical structures report such high-impact publications. The publications in many of the other areas have a more modest international impact.

Under the global research environment two concrete examples were given of the institute's global presence, namely, the Telos Alliance in the US and collaboration with EBI. These are good examples, but two are too few to suggest an active world class presence for an institute of this size.

The claim of world class research groups is not sufficiently justified by the recorded publication list, international grant funding success or prestigious invitations such as keynote addresses at seminars and conferences.

Economic impact

Score: 3 - good

There have been several projects with companies which demonstrate technology transfer from the institute's computing activities. Possibilities from the mathematics sector are in the energy domain.

A significant commercial relationship with a private actor has been ongoing for many years, on pro-audio networks with Telos, USA, realising funding at a level of about 195 k € per year. Otherwise, the economic impact of the institute is generally focused on joint research projects and contract research for a variety of government entities such as the Ministry of Defence, the Prosecution Office, the Enterprise Register, NATO agencies, the Latvian Language Agency, etc.

The institute is responsible for promoting cyber security in Latvia which is an important and essential role and a necessity for Latvia. It also provides the e-infrastructure for the Faculty of Computing.

Social impact

Score: 4 – very good

The institute plays an extensive role in the public sector of Latvia. It provides the top-level .lv domain name service, and it is responsible for promoting cyber security, securing critical national e-infrastructure, and responding to security incidents in Latvia. The network solutions department also contributes internationally to ICANN and to the policy development for domain name registration under the .lv domain. The above functions are of course critical for the country and the university, but are more of a service, and not an impact that emerges from the research that takes place at the institute.

The technology support for the Latvian language that is provided by the institute is a socially impactful activity much more closely interwoven with research. For example, the institute provides corpuses of the Latvian language.

Research environment and infrastructure

Score: 3 - good

There are new premises completed in 2019 and a jointly maintained e-infrastructure consisting of a wide range of equipment which is used by the university's wider researcher community. The research infrastructure is described under three headings, namely, network, data centre and computing infrastructure and adequately supports essential facilities and services for a wide range of researchers. This infrastructure is at a satisfactory, international-level standard.

Overall, the environment in terms of organisation, group structure, and management seems somewhat fragmented. There is a mix of service provision and research, the activities are divided into many groups operating largely independently.

Development potential

Score: 3 - good

The research strategy is to build on current strengths, encourage international publication and engagement, support young researchers etc. Many of the principal factors listed would be expect to find in a well organised research institute. There is a salary incentive scheme and the possibility of staff doing outside paid work, however, it does have an impact on the institute's research output. The involvement of researchers visiting the institute has not reached the desired level.

There is such a wide range of topics that it is probably impractical to achieve an international performance level in all of them. Some of the topics are highly relevant and important, for example, in machine learning and cyber security. It may be possible to refine and focus the institute's research so that some topics can perform at the international level.

During the evaluation period, the institute has taken some commendable steps, such as the decision to promote publications in internationally indexed venues. Some of the groups have even been able to appear in top-tier venues. Also, the institute has been successful in attracting both Latvian and European research grants.

On the other hand, there are also concerns to be taken into account that can limit the development potential: the structure as both a service provider and a research institute, the fragmented research, where not all parts are on par with international standards, and the status of the institute - not being allowed to grant PhDs.

Potential to offer doctoral studies

There is no PhD Programme and as a result staff must participate with PhD students in other Departments and Universities. Over the period 13 PhD dissertations have been supervised, presumably jointly. Since 2016 the institute has managed to attract funding for 4 postdoctoral fellows.

The institute needs to ensure that it has a PhD programme either as its own separate PhD programme or as a joint PhD programme with other Universities.

Alignment with Smart Specialisation Strategy

The institute topics are well within the remit of the RIS3 objectives and specialisation areas and it is making contributions to their realisation. In addition, institute members are members of many bodies and associations in Latvia and some international bodies. There have also been some commercial activities with an important link up with US companies in audio networks which is relevant to RIS3.

Conformity with state scientific and technology development

The institute is involved to a high degree with the state's scientific and technology development since it provides national cyber security on which such developments depend.

The institute is collaborating with industry in a number of projects locally and in one case in the USA. Research at the international level is diverse and could benefit from a more focused approach. Grant applications are healthy, 20 to the Latvian Research Council, 13 to the ERDF, 27 to the EU Framework Programme. Although the success rate is not high the fact that grants are submitted is encouraging.

Recommendations

The institute performs a valuable service function within the University by providing the University's computing infrastructure and provides an essential national service through its domain and cybersecurity services. These service functions do not fit easily into an

international research entity. It is recommended that the service functions and research activities be separated into different structures.

The age distribution of the staff was mentioned as an issue in the last review, but it seems that little progress has been made in addressing this problem despite the fact that the last review said that to do so was essential. The academic research personnel have seen 30 % decline over the 2013-2018 period. It is recommended that the staff decline problem be urgently addressed.

The institute does have some promising research activities as mentioned above. However, the research output in journals has seen an increase and then a decline which may be associated with the staff numbers decline. It is recommended that the research be more focused and high impact journals be targeted as publication venues.

The last review recommended merging the institute's Mathematics section with the Department of Mathematics. This has not been done. It is recommended that this be examined again as there seems to be little research synergy between the two main entities of the institute.

The institute plays an important role in the country's computing infrastructure and it is recommended that this is well funded by the government as cybersecurity is not only essential but critical in the current international climate.

3 Summary of findings across the set of institutional evaluations

The general level of quality of research

Figure 17 Average scores across the institutes

Criteria	Scores
Quality of the research	2.44
Impact on the scientific discipline	2.31
Economic impact	2.81
Social impact	3.06
Research environment and infrastructure	2.69
Development potential	2.94
OVERALL SCORE	**2.69**

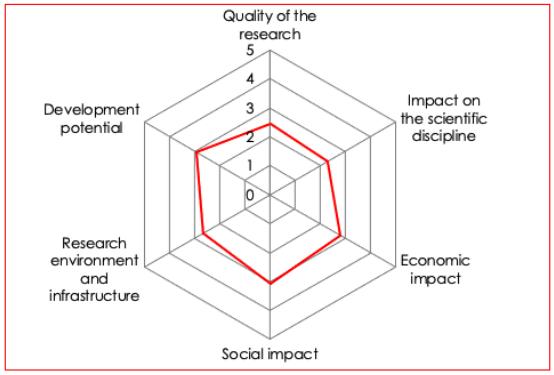
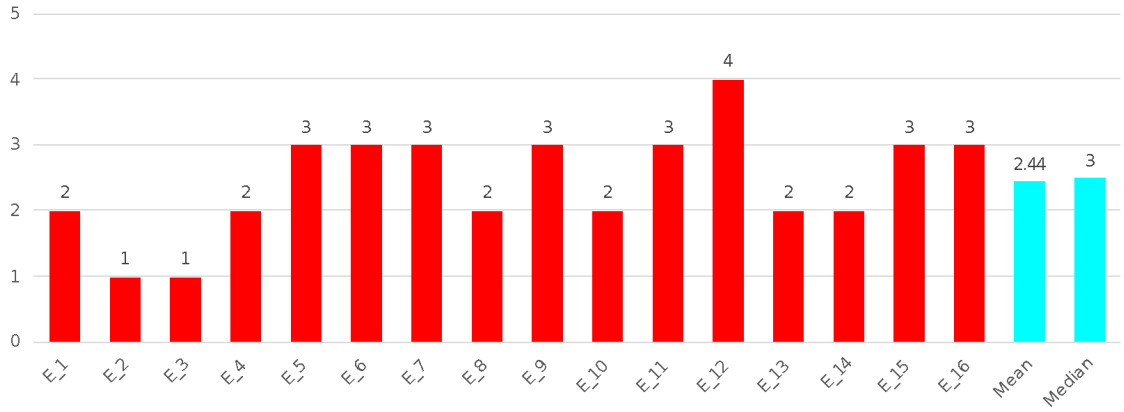


Figure 18 'Quality of the research' scores across the institutes, mean and median



E_1 Institute of Physical Energetics

E_2 ISMA University, ISMA Computer Technology Laboratory

E_3 The Research Institute of Latvian Maritime Academy

E_4 Rezekne Academy of Technology Institute of Engineering

E_5 Riga Technical University, Faculty of Civil Engineering

E_6 Transport and telecommunication institute

E_7 Riga Technical University, Faculty of Electronics and Telecommunications

E_8 Ventspils University of Applied Sciences, Engineering and technology research platform

E_9 Riga Technical University Faculty of Materials Science and Applied Chemistry

E_10 Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics

E_11 Riga Technical University, Faculty of Power and Electrical Engineering

E_12 Institute of Electronics and Computer Science

E_13 Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit

E_14 Liepaja University, Engineering and Technologies Unit

E_15 Riga Technical University, Faculty of Computer Science and Information Technology

E_16 University of Latvia, Institute of Mathematics and Computer Science

During the last assessment exercise in 2014, the Panel examined the submissions from 37 research units (RU) from across Latvian University and Research Institutions in engineering. As a result of the 2014 recommendations, a number of research units were combined as recommended by the Panel so that on this occasion a total of 16 research units were assessed. Of the 16 units some were private institutions (2), some were stand-alone research institutes (4) and the majority were in universities (10).

The submissions varied greatly in the level of detail and the content which made assessment difficult in some cases. Each submission was read in detail by at least two Panel members and then discussed by the whole Panel on at least two occasions, namely, before and after the virtual Panel visits to the research units. Unfortunately, due to the Coronavirus pandemic, it was not possible physically to visit any of the units and as result visits took place via Zoom, supplemented by videos of the units' facilities. The Panel would like to express its thanks to all the members of the research units -staff, students, and collaborators - that they met virtually and appreciate their input and comments which they found very valuable.

The research activities assessed covered a broad range of engineering topics and included, computer science, structural engineering, bio-engineering, digital signal processing, embedded systems, heat, gas, and light technologies. The nature of the research was both theoretical and applied with many projects making a major contribution to Latvian society and industry while others were having an impact outside Latvia.

As a result of in-depth examination of the submissions, the virtual visits and detailed discussions of each submission the Panel has concluded the following:

• The RUs with score 4 (Strong International Player) are performing well and have potential for further development

- Riga Technical University Faculty of Materials Science and Applied Chemistry
- Riga Technical University Faculty of Power and Electrical Engineering
- Riga Technical University Faculty of Computer Science and Information Technology
- Institute of Electronics and Computer Science

• The RUs with score 3 (Strong National Player with some International Recognition) are making progress and improving their performance

- University of Latvia, Institute of Mathematics and Computer Science
- Riga Technical University, Faculty of Electronics and Telecommunications
- Riga Technical University, Faculty of Civil Engineering
- Latvia University of Life Sciences and Technologies, Engineering and Technologies Unit
- Transport and Telecommunication Institute

• The RUs with score 2 (Satisfactory National Player) are not performing well on the international arena

- Institute of Physical Energetics
- Rezekne Academy of Technology Institute of Engineering
- Riga Technical University Faculty of Mechanical Engineering, Transport and Aeronautics
- Ventspils University of Applied Sciences Engineering and Technology research platform
- Liepaja University Engineering and Technologies Unit

• It is difficult to see how the performance of the RUs with score 1 (Poor National Player). can be improved to the international level

- ISMA Computer Technology Laboratory
- The Research Institute of Latvian Maritime Academy

Key strengths

In the previous assessment exercise, many of the research units lacked critical mass, and this was limiting their potential. The Panel was pleased to note that fragmentation has been reduced and appropriate amalgamation of units has taken place.

Another issue was that much of the research work was reported in regional journals and conferences, which lacked impact and were not widely read or regarded internationally. The publication output across the units has in general improved greatly with a concentration on publishing in well-recognised journals and conferences appearing in the Web of Science and Scopus databases. Although there is marked improvement, there is still room for improvement in many cases via targeting of more prestigious publication channels.

A noticeable improvement in many units was the reorganization that had taken place and the effective management structures which have been established. In many cases the top managers of the organisations concerned were directly involved in ensuring the units were operating effectively and in supporting them.

There has also been a noticeable improvement in the infrastructure in many units. For example, many now have new and well-equipped buildings with equipment and facilities which are comparable with similar institutions in the EU-15.

Many of the units assessed are playing major roles in the socio-economic development of Latvia, not only as advisers but also with direct inputs. For example, the provision of graduates and the increasing number of joint projects and spin off companies in this area is benefiting Latvian industry and commerce. It is important that this activity is encouraged and sustained.

There has been commendable improvement in Latvian participation in European competitive research projects, which has led to a substantial injection of funds into Latvian research. This provides a good platform for future research collaboration and has been identified in particular units as an area to be exploited.

Main weaknesses

The staff in general was found to be dominated by personnel from the Baltic region. The Panel would like to see more hiring of international researchers and more international visitors. Latvian engineering has some very good contacts and projects throughout Europe which should be exploited to enhance Latvia's staffing, participation and contribution.

Across the units there were different doctoral programmes in place. Some units did not operate their own doctoral programme and were therefore supervising doctoral students registered elsewhere. The Panel believes that the provision of a doctoral programme is essential for a modern-day research unit for many obvious reasons but primarily to ensure a supply of future researchers. In the interviews with the students, the Panel was impressed with their knowledge and commitment which is a good omen for future research. All Latvian non-university engineering institutions carrying out research should be associated with a University. All institutions should have their own PhD programme or be formally linked into the PhD programme of a University.

In general, the Panel feels that the provision of doctoral programmes across Latvian universities and research institutions needs to be standardised by the appropriate government department.

There is a slight concern that many units are over-concentrating on applied research, for example, in response to national strategy documents so that theoretical research will be neglected. In many subjects, both theoretical and applied research are required and both are essential. Theoretical research is the underpinning activity and could benefit from a national initiative to complement, for example, SIS3.

Conclusions

There are many encouraging signs of improving international research in the units scored 4 and 3 in this assessment.

Amalgamation of previous smaller units has taken place to create more focused research areas and a critical mass of personnel to carry out national and international research.

There has been greater emphasis on targeting publications in more prestigious journals and conferences with a resultant quality improvement.

The infrastructure in many units has been modernised and has better equipped Latvian researchers to compete more effectively in European projects. The amount of funding received through competitive European research programmes has greatly increased and there are encouraging signs of more activity in this area.

There has been increased involvement by the units in projects with local industry and commerce. The units are producing graduates who are benefiting the socio-economic climate of Latvia. There are still some problems in that, for example, in the IT sector the demand for graduates exceeds the supply.

Recommendations

There has been a very good improvement in many units since the last assessment exercise. Many units now have a solid management structure, a well-equipped infrastructure and an improved environment, and are producing well-qualified graduates. It is important that these improvements are not lost and that the units continue to pursue the main criteria for successful international research, namely:

- Publications in prestigious journals and conferences.
- Lead and/or participate in more EU and international competitive research and development programmes.
- Ensure sustainability and enhancement of the infrastructure.
- Broaden the staff experience and ensure more international appointments.
- Ensure reward for successful international cooperation and collaboration.
- Ensure staff have the opportunity for a year's sabbatical leave.
- Rationalize the PHD programmes across research units.
- Expand the number of international visitors

Appendix A Feedback on Panel assessment

Feedback received from Rezekne Academy of Technology Institute of Engineering

23 February 2021

Developed by: Director of the Institute of Engineering Dr.sc.ing. Sergejs Kodors
Verified by: Dean of the Engineering faculty Erika Teirumnieka;
Chairman of the Scientific Council of the Institute of Engineering Dr.sc.ing. Prof. Edmunds Teirumnieks

The response of the Institute of Engineering to the provided assessment

Dear experts of international evaluation of scientific institution!

We have received a report from the expert group on the evaluation of the scientific institution - the Institute of Engineering of Rezekne Academy of Technologies - which we have to harmonise before 25 February 2021.

Please note that we disagree with much of the information provided in the expert report.
We recall that, after the remote meeting with the experts, Rezekne Academy of Technologies immediately informed Anete Vingre (anete.vingre@technopolis-group.com) about the objections regarding the evaluation process (see attachment) emphasizing that the Director of the Institute Dr.sc.ing. Sergejs Kodors was not allowed to finish his presentation on the Institute. The presentation was interrupted and we were not able to provide comprehensive information on the issues which were later underestimated by the experts in the report; that does not correspond to the actual situation. It is possible that the remote meeting with the experts has caused communication problems leading to an incomplete current situation assessment.
Rezekne Academy of Technologies has already encountered a similar situation several times during remote communication.
The following are our comments and explanatory information on the issues that were either misunderstood or not fully explained due to the reasons stated above.
We hope that, based on the information we provide, the expert opinion/assessment will be reviewed and changed according to the criteria we substantiate.

The researchers of the Institute thank the experts for the evaluation of the Institute!

P.S. After the meeting/discussion with the experts, many recommendations have already been taken into account and we try to implement them as much as possible.

Impact on the scientific discipline

We consider it necessary to draw the experts` attention to factual inaccuracies in the provided assessment of the Institute of Engineering of Rezekne Academy of Technologies (hereinafter referred as Institute).

Firstly, we assume that there is an error or misunderstanding in the assessment of Institute partners. The international partner of our Institute is "Angel Kanchev" University of **Ruse** (https://www.uni-ruse.bg/en), not Russia. The University of Ruse is our partner which participates in the implementation of the joint doctoral study programme "Laser Technology" which is undergoing the licensing process in Quality Agency for Higher Education.

Secondly, ERASMUS projects are considered as collaboration projects neither research projects according to the self-assessment methodology. During the discussion, international partners of the Institute emphasized Erasmus projects because these projects had provided the framework for the next scientific collaboration. The goal of the Erasmus programme is, in particular, the development of international and inter-institutional communication.

Thirdly, we disagree with the conclusions that the "institute has developed active communication with a very limited number of EU universities" and "limited impact also at the national level" because national and international collaboration only with monetary value must be depicted considering self-assessment guidelines. Meanwhile, the Rezekne Academy of Technologies (including the Institute) has a large list of national and international partners from countries like Germany and Bulgaria. The collaboration contracts consider joint scientific work, joint conferences, reviewing and the development of projects. The partial list of partners is provided in https://www.rta.lv/izi_collaboration

Research environment and infrastructure

We can not accept the Commission's comment that the Institute has too many technical staff, low salaries and a small number of researchers since Research Assessment Exercise 2013 provided the next comment "The number of technical personnel is low (0.5) for this sophisticated equipment. Although the funding per researcher is unusually high (5th of all institutions)". We considered this comment provided in the report 2013 when we were planning our next development. We have completed the requirements of the previous assessment, but now we get negative remarks about it. In our view, the commission must consider the fulfilment of the previous recommendations and how they are solved - the assessment must be consequent. We agree that the number of researchers should be increased. However, the technical personnel is a way to renew research staff: they start as laboratory assistants, continue their development in doctoral studies and become researchers.

We disagree with the conclusion that the Institute has a small number of international researchers. In our view, a quality assessment must consider the proportion rather than the amount. The human resources are depicted using FTE, the FTE of international researchers is approximately 20% in the Institute. Meanwhile, there is a recommendation that international researchers should account 5% of FTE in Latvian universities and scientific institutes.

We see a contradiction in the conclusions of the experts, as they depict, in their report, that the Institute has very small funding to employ staff. At the same time, they note a large number of technical staff. We wish to emphasize that technical staff is strongly important for applied and engineering science because they are the ones who develop prototypes and complete experiments, which is a time-consuming process.

Though SWOT provides the objective conclusion that low salaries decrease the possibility to employ the preferable amount of staff, it does not mean that the Institute has not applied all possible solutions to develop the appropriate scientific work model considering the provided funding to achieve strategic tasks, create a synergy of the study process and research, and educate society with a goal to develop knowledge-based innovations.

Economic impact

The report of the commission considers only monetary collaboration with non-academic partners. However, the requirements and assessment methodology underlines the importance of scientific work for society. The scientific institutes, which are based on the infrastructure of universities, realize the main important social task - to renew human resources providing a bridge between innovations/science and education. From this collaboration, the private sector obtains new specialists and products developed by students as their diploma projects within the framework of their master and doctoral theses. In our view, the commission has no sufficient understanding of the principles of science funding in Latvia, relations between education and research, and the most important public value provided by the research institutes based on the state universities. The assessment based on financial criteria only could be applied to private institutes or for profit-oriented companies.

Development potential

We think that the strategy and plans of the Institute are reliable and achievable based on the statistical results of the Institute development 2019-2020, which the commission refused to hear during the remote visit. Currently, the Institute employs one more international researcher and has participated in 20% of all national research projects related to overcoming the Covid-2019 pandemic; the total number of scientific projects has been doubled, the new Laser Centre has been built, new AI laboratory has been developed and three new AI engineers/ young researchers have been employed under new scientific project.

Rezekne Academy of Technologies, including the Institute of Engineering, is a member of the consortium European Cross-Border University (UNIVERS) starting from 2019, which includes the following partners: Rezekne Academy of Technologies (Latvia), University of Perpignan (France), Bialystok University of Technology (Poland), Chemnitz University of Technology (Germany), University of Craiova (Romania), University of Girona (Spain), University of Lleida (Spain), and University of Ruse (Bulgaria). The main goal of the consortium is the joint project development and submission of them to the European funding programmes like Horizon 2020, Horizon Europe, as well as participation in the projects of the partners (for example, the project DAAD (German Academic Exchange Service) programme “Europäische

Hochschulnetzwerke (EUN) – Nationale Initiative" Chemnitz University of Technology, which considers the development of the joint master and doctoral study programmes, as well as inter-institution education exchange to improve the scientific capacity of PhD students and joint project implementation.

Currently, the doctoral study programme "Laser Technology" of Rezekne Academy of Technologies goes through the licensing process at the Quality Agency for Higher Education. This PhD programme will be realised together with the University of Ruse (Bulgaria) and universities from Germany together with laser manufacturers. Meanwhile, the Rezekne Academy of Technologies already has active collaboration with the University of Ruse.

Potential to offer doctoral studies

From the outset, all PhD study programmes of Rezekne Academy of Technologies have been realized together with other national and international universities. At this moment, the doctoral study programme "Laser Technology" of Rezekne Academy of Technologies is going through the licensing process at the Quality Agency for Higher Education. This PhD programme will be realized together with the University of Ruse (Bulgaria) and universities from Germany as well as together with laser manufacturers. Meanwhile, the Rezekne Academy of Technologies already has active collaboration with the University of Ruse.

Quality of Research

We think that the parameter "Quality of Research" must be revised. According to the description of the third level requirements only "some international recognition" and "could publish work" have to be proved. It does not mean that all fields must have an international recognition level, it is sufficient to prove a partial match. We defend our point of view that the topic "laser technologies" sufficiently meets the requirements because the requirement "strong international player" is applied to the fourth level. Considering the comment of the commission about a wide range of topics (25), this list can be reformulated with one definition "engineering science". The provided list of topics depicts the areas of expertise of the researchers working at the Institute. The accreditation is completed for the whole field of "engineering science", not for a specific direction, like AI or IoT. At the same time, many research directions are closely linked and inseparable. According to the scientific strategies of Latvia and Rezekne Academy of Technologies, priority must be given to transdisciplinary research. According to the national recommendations, studies are based on science and research in Latvia. The research directions of the Institute are closely linked with the directions of the study programmes which are implemented at the Faculty of Engineering. Collaboration with entrepreneurs takes place in all directions, although not all cooperation actions take the form of financial contracts. Studies for entrepreneurs are also carried out within the framework of student and PhD research projects.

According to the comment of the commission that the Institute has a limited membership of committees and in scientific advisory boards of non-academic entities. We think that the commission must take into attention that there were many restructuring processes and researchers of engineering direction restarted their activity under the one

department “Institute of Engineering” in 2018. Meanwhile, these restructurations were completed to satisfy requirements, including recommendations and comments on the previously provided assessment. After 2018, researchers of the Institute have been members of many international committees, for example:

Edmunds Teirumnieks:

- Member of the Scientific Committee: “The Conference of Environmental and Climate Technologies CONNECT” 2020, 2021. Riga, Latvia. Institute of Energy Systems and Environment, Riga Technical University.
- Member of the International Advisory Committee: 21st International Conference and School on Quantum Electronics “Laser Physics and Applications” (ICSQE 2020), 21-24 September 2020. Institute of Electronics, Bulgarian Academy of Sciences.
- Member of the International Program Committee: 4th-9th International Scientific Conference “TechSys” - Engineering, Technology and Systems. Sofia Technical University. Plovdiv Branch. Bulgaria. 2015 - 2020.
- Co-Chair of the Organizing Committee: “International scientific conference, defence technology forum” “Vasil Levski” National Military University, “Artillery, Aircraft Defense and CIS” Faculty. Shumen, Bulgaria. 2018 - 2020.

Lyubomir Lazov:

- Editorial board member of the International scientific journal “Science. Business. Society”. Publishers: Scientific Technical Union of Mechanical Engineering, National Society “Industrial & National Security”. Year I, Issue 2/2016. ISSN 2367-8380.
- Editorial board member of the International scientific journal “Science. Business. Society”. Publishers: Scientific Technical Union of Mechanical Engineering “Industry 4.0”, National Society “Industrial & National Security”. Year II, Issue 1/2017. ISSN print 2367-8380, ISSN web 2534-8485.
- Editorial board member of the International scientific journal “Science. Business. Society”. Publishers: Scientific Technical Union of Mechanical Engineering “Industry 4.0”, National Society “Industrial & National Security”. Year III, Issue 3/2018. ISSN print 2367-8380, ISSN web 2534-8485.
- Editorial board member of the International scientific journal “Science. Business. Society”. Publishers: Scientific Technical Union of Mechanical Engineering “Industry 4.0”, National Society “Industrial & National Security”. Year IV, Issue 4/2019. ISSN print 2367-8380, ISSN web 2534-8485.
- Editorial board member of the International scientific journal “Science. Business. Society”. Publishers: Scientific Technical Union of Mechanical Engineering “Industry 4.0”, National Society “Industrial & National Security”. Year V, Issue 3/2020. ISSN print 2367-8380, ISSN web 2534-8485.
- Member of the International Scientific Committee of the Annual scientific conference of Vasil Levski National Military University – June 2017, 2018, 2019, 2020.

- Member of the International Scientific Committee of the Annual scientific conference „Current security issues" of Vasil Levski National Military University - October 2017, 2018, 2019, 2020.
- Member of the International Advisory Committee: 21st International Conference and School on Quantum Electronics "Laser Physics and Applications" (ICSQE 2020), 21-24 September 2020. Institute of Electronics, Bulgarian Academy of Sciences.
- Member of the Reviewers Committee of the Organizing Committee: "International scientific conference". "Vasil Levski" National Military University, "Artillery, Aircraft Defense and CIS" Faculty. Shumen, Bulgaria. 2018, 2019, 2020.

Artis Teilāns:
Special session Programm Committee member:

- 11th International Conference on Evaluation of Novel Software Approaches to Software Engineering - ENASE 2016. Special Session on Model-Driven Innovations for Software Engineering - MDI4SE 2016 (http://www.enase.org/MDI4SE.aspx?y=2016)
- 12th International Conference on Evaluation of Novel Approaches to Software Engineering - ENASE 2017. Special Session on Model-Driven Innovations for Software Engineering - MDI4SE 2017 (http://www.enase.org/MDI4SE.aspx?y=2017).
- INTERNATIONAL SCIENTIFIC CONFERENCE, DEFENSE TECHNOLOGY FORUM. "Vasil Levski" National Military University, "Artillery, Aircraft Defense and CIS" Faculty. Shumen, Bulgaria, 2018, 2020. Reviewers committee member.

Additionally, the Institute is sometimes stated under the organisation Rezekne Academy of Technologies, as the Institute of Engineering is a Rezekne Academy of Technologies unit. For example, Rezekne Academy of Technologies, including the Institute, is a member of many associations like: German-Baltic Chamber of Commerce (AHK - Deutsch-Baltische Handelskammer in Estland, Lettland und Litauen), The Association of Mechanical Engineering and Metalworking Industries of Latvia (MASOC), Latvian Information and communications technology association (LIKTA), Latvian Electrical Engineering and Electronics Industry Association (LETERA) etc.

By invoking assessment methodology guidelines, the Rezekne Academy of Technologies including the Institute of Engineering considers that all quality parameters of the Institute are strongly reduced by the commission. Rezekne Academy of Technologies has already informed Technopolis Ltd. about many contradictions in the visit time. The provided report depicts similar contradictions.

Considering the above arguments, Rezekne Academy of Technologies asks the experts to review the assessments of the Institute of Engineering.

Feedback received from the Institute of Physical Energetics

Riga, 24/02/2021

Dear Madam, Sir,

Thank you for the performed evaluation for the Institute of Physical Energetics (IPE). We made the careful acquaintance of the Evaluation and would like to point out some comments which, in our consideration, might be relevant.

1. Number of Master students

The Evaluation states – "no Master's students are listed". Regarding the Master students, we would like to explain the following. In the Self-report we had not included the number of Master students due to two reasons: (1) the IPE has no right for Master's Thesis Defence Council (as this right has only higher education institutions) and (2) unfortunately the self-reporting format did not clearly state how to report number of defended Master thesis.

In real practice, in the period 2013-2018 the staff of IPE had led 24 Master thesis which were successfully defended as well as the staff of IPE by themselves had defended 8 Master thesis. We apologize for this misunderstanding.

2. Economic impact

The Evaluation notes that the impact of IPE performed research is not well demonstrated and is unclear.

We would like to underline that developed research methods and performed research projects have significant economic impact in Latvia. We would like also to refer to the information we had provided in the Self-report, the section 1.6.

- IPE had carried out the assessments which had served for evaluation of Latvia's participation in GHG emissions trading under the UNFCCC Kyoto Protocol. As a result of Latvia participation in the international GHG emissions trading, national budget had attracted additional finances. The total amount received by the national budget was over EUR 200 million which were spent to finance energy efficiency improvement measures and implementation of renewable energy source in all sectors of economy.

- IPE had carried out the evaluation of long-term development scenarios, both energy efficiency and use of renewable energy sources, for Latvia's energy development by 2030 to meet national climate and energy targets. Essentially, the developed scenarios had identified and described the particular energy efficiency improvement measures to be implemented in each of the energy end-use sectors. The results of this research had make the background for the National Energy Climate Plan 2021-2030 (NECP2030) which is adopted by the national government. Within the total period of the Plan, over 1000 million EUR additional investments, including for energy efficiency improvements, are planned. In its turn, the implementing of the Plan provides annual savings of around 140 million EUR of the total costs of energy system.

Thus, within the performed research IPE provides complex solutions for long-term development of the energy demand-supply system which allows for the energy efficiency improvement and related cost reduction and cost-effective development of the overall system, reduce the risks associated with security of energy supply, provides sustainability, competitiveness and growth of national economy.

Sincerely Yours,

Gaidis Klāvs director

Feedback received from the Institute of Mathematics and Computer Science, University of Latvia

Thank you for considering our research and providing your perspective on it. We find, however, that several principal issues have not found their proper reflection in the evaluation report.

1. Within **Quality of Research** section:

- The work on *computer security* has been described as of low impact on the international scientific arena. While we agree that this is a yet developing research area at the institute, we note that our work has been published in prominent research conferences, both within 2013-2018 and beyond, as e.g.:
    - *Bbuzz: A bit-aware fuzzing framework for network protocol systematic reverse engineering and analysis*, Blumbergs, B., Vaarandi, R. Proceedings - IEEE Military Communications Conference MILCOM, 2017, 2017-October, pp. 707–712 (SCOPUS citation count 4)
      This publication can be attributed also a practical impact at NATO level regarding its air traffic command and control centre capability vulnerabilities.
    - *Remote exploit development for cyber red team computer network operations targeting industrial control systems*, Blumbergs, B. ICISSP 2019 - Proceedings of the 5th International Conference on Information Systems Security and Privacy, 2019, pp. 88–99.
      This publication has had an impact on the cyber security problem mitigations, primarily, within the EU and North American distributed power grids.

- The work in *machine learning* has been described to be of modest success. We note that this work has been (and still is) of fundamental horizontal importance for IMCS UL research, ranging from language technologies (where the world-class SemEval prizes would not have been possible without machine learning solutions) to bioinformatics (with the research resulting in a Proteomics publication in 2020, in cooperation with EBI, Institute of Cancer Research (UK) and University of Bergen). The research on fundamentally novel machine learning methods has been active, as well, resulting in a publication of K.Freivalds et.al. within 2013-2018 and later by a publication at NeurIPS 2019, the world leading conference on machine learning.

- The *staff age profile* has been named a major concern (mentioned also in the **Recommendations** section). We note that any remaining age irregularities that IMCS UL may have are being naturally remedied by a growing new generation of research leaders below 40 years of age (N.Grūzītis, Ag.Šostaks, A.Sproģis, U.Strautiņš, B.Blumbergs, P.Paikens, E.Kalniņa) and in 40-ies (K.Freivalds, I.Auziņa). The work of the young research leaders is accompanied by the leaders currently in 50-ies (G.Bārzdiņš, J.Vīksna, K.Čerāns, S.Asmuss, I.Skadiņa), as well as supported by a still active and productive elder researcher generation (J.Bārzdiņš, A.Kalniņš, Al.Šostaks, F.Sadyrbaev, R.Balodis, M.Alberts). The share of researcher FTE at IMCS UL attributed to researchers aged 60 and above has decreased from 32% in 2015, to 24% in 2018 and further to 20.5% in 2020, so it would not be fair to conclude that little progress has been made in addressing the staff age problem since the last evaluation (as stated in the **Recommendations** section).

2. Within **Impact on the scientific discipline** section only two concrete examples of the Institute's global presence have been reported (cooperation with Telos Alliance and EBI).

We would see it appropriate to have at least the following items added to the list (and increasing the "global presence" count accordingly), as they indicate long-term high-profile international cooperation and IMCS UL presence:

- Cooperation with Deutsche Welle, Priberam Informatica SA and other consortia members of related EU Horizon projects SUMMA (2016-2019, via SIA LETA) and SELMA (since 2021) within the machine learning and language technology area, showing a stable and ongoing interest of the partners in the IMCS UL research within the highest-profile projects, and

- Cooperation with NATO Cooperative Cyber Defence Centre of Excellence (NATO CCDCoE) in the computer security area involving:
    - joint publications in prominent conferences, both within 2013-2018 and beyond (as explained in our response to the *Quality of Research* section),
    - joint organization of International Cyber security exercises, such as, "Locked Shields" and "Crossed swords" (reported in B.Blumbergs' PhD thesis and research publications) including other activities, as developing and teaching technical courses "Malware and Exploitation Essentials" (2013-2019) and "IT System Attack and Defence" (2013-2017) that are not of primarily academic nature, however, that have a significant component of research performed on their basis
    - development of IMCS UL cyber-security team (PhD studies of B.Blumbergs at Tallinn University of Technology, with deployment at NATO CCDCoE)
    - involvement of IMCS UL staff within NATO CCDCoE structures (B.Blumbergs as an ambassador of NATO CCDCoE, also researchers K.Podins and B.Blumbergs have been Latvian representatives at CCDCoE for extended terms),
    - Participation of B.Blumbergs in the program committee of IEEE co-sponsored NATO CyCon conference (since 2013).

The IMCS UL international cooperation has an even much wider scope, as has been demonstrated in Section 5.4 of our self-evaluation report.

3. We would find it appropriate to have the **Economic Impact** evaluation updated to reflect the following important facts:

- The Institute activities in the cybersecurity and .LV top-level domain administration are of principal importance for the Latvian economy and society, these are carried through under quarterly evaluation from the Ministry of Defence and Ministry of Transport, including evaluation of the activity impact on the public administration.

- The cyber-security function has been entrusted to the Institute by Latvian Law on Information Technology security. The Law also explicitly defines cyber-security research as a part to the cyber-security function, viewed as essential for new innovative cyber-security solution and service development.

- In 2019, the Institute has been awarded a Letter of Recognition from the Cabinet of Ministers "for a significant and long-term contribution to the development of the Information and Communication Technology Sector in Latvia".

We would also appreciate including a qualitative assessment of the alignment [of our work] with the objectives, development of priorities and areas of the Smart Specialisation Strategy into the **Economic Impact** description, as described in the template for the evaluation report, and aligning our **Economic Impact** score with the impact we produce through these activities.

4. Regarding the **Research environment and infrastructure** description, we would disagree with the conclusion that the research environment is fragmented. According to local legal requirements, each project must be handled as a separate activity to ensure that there is no cross-funding between projects. We acknowledge that the high number of internationally reviewed national projects at the IMCS UL in combination with the aforementioned requirement for separation may create impression of fragmentation. However, we disagree that this is mentioned as a shortcoming of the research environment at the IMCS UL.

The high level of IMCS UL research infrastructure has also been well demonstrated by its use in large international collaboration networks and projects. IMCS UL is a member of CLARIN ERIC and actively participates in the development of CLARIN international research infrastructure. It is available to international scientists who need access to language resources.

As rightfully recognized by the experts, our research infrastructure "is used by the university's wider research community". Among those researchers, there are high-level international scientists (e.g. researchers from A.Ambainis group UL). Although those scientists are Latvian nationals, they carry out high-level international research and use infrastructure provided by the IMCS UL. It also should be noted that our research infrastructure is used by high-level international scientists outside Latvia, e.g. in collaborations with EBI, IARC and CEPH in bioinformatics, ENISA and NATO professional training courses in cybersecurity.

Considering everything mentioned above, we believe that the IMCS UL is a strong international player and provides an excellent research environment which should be reflected in the evaluation report.

5. The co-existence and interplay of a diverse range of activities, involving more research-oriented ones (including research in both Mathematics and Computer Science) and more service-oriented ones has not been recognized as a strength of the Institute. This has resulted in an unfortunate recommendation to consider the different activity separation (cf. **Overall score** section, **Research environment and infrastructure** section, as well as **Development potential** and **Recommendations**).

Such a recommendation does not consider several factual and conceptual arguments that explain the synergy of working together and developing as a joint entity:

- The CERT.LV laboratory provides a real-world context and data for the research in the cyber-security direction, which IMCS UL sees as one of its research priorities and where IMCS UL has a potential for high-profile academically and practically relevant research and international collaboration. This is confirmed by:
    - Research publications in computer security, published in prominent conferences,
    - Existing cooperation with NATO CCDCoE and Tallinn University of Technology,
    - Newly obtained research grants involving researchers from both CERT.LV (B.Blumbergs) and other IMCS UL laboratories (P.Paikens from AI laboratory),
    - Grant applications in the computer security area towards ERDF, as well as towards cross-border (Baltic States and Norway) financial instruments
    - Participation of our researchers (B,Blumbergs) in international conference program committees, including, NATO CyCon conference (IEEE co-sponsored).

- Performing research in cyber-security is one of principal tasks put forth to CERT.LV by Latvian Information Technology Security Law that determines CERT.LV duties and structure, as well as its placement at IMCS UL as an academic research institution. The synergy of the cyber-security research and practice is expected to both have an academic importance, and to promote creating new innovative cyber-security services and solutions, essential for the society and the economy.

- There is a joint infrastructure, involving the networking (GEANT, High-speed Intranet) and computing facilities (HPC, QKD), supported by and essential for the research in both Mathematics and Computer Science, as well as the more service-oriented activities.

- The Mathematics and Computer Science research are together at the Institute for historic reasons, fully relevant also nowadays, as research in both these disciplines rely on the computation power provided at the Institute, and as Mathematics provides the theoretical foundations for the Computer Science, e.g., in Machine Learning, Data Science and Cryptography that are of growing practical importance.

- A large part of research papers in Computer Science published by IMCS UL fit also under the Mathematics discipline (about 30% of IMCS UL Computer Science publications indexed in SCOPUS since 2013 are attributed in SCOPUS also to Mathematics discipline). This signifies the inherent interdisciplinarity of our Computer Science research with Mathematics (sound mathematical foundations is an important principle for our Computer Science research, as well).

- The academic affiliation of both CERT.LV and NIC.LV services at IMCS UL has allowed their implementation in a high-quality and internationally well-recognized way (cf. the international affiliations of Baiba Kaškina (chair of GEANT Task Force TF-CSIRT) and Katrīna Sataki (chair of the Council of the ccNSO)), growing out of the friendly academic research environment and contributing back the research problems into the more academic-oriented laboratories.

That would be a loss, if the cybersecurity function and other service-oriented activities of the Institute would be further separated from its more research-oriented activities.

6. The **Recommendations** section stresses the urgent need to address the staff decline problem. Although clearly the expansion of the work volume is one of our highest priorities, we would appreciate, if the recommendation would contextualize the issue with our analysis (provided in the self-evaluation report) including:

- re-structuring of the research financing and remuneration policy while not increasing the research financing itself, and
- the perspective of re-gaining the researcher FTE increase in 2019 on a new quality level due to starting of new projects in 2019 (the work for obtaining these projects has been done up to 2018).

The factual situation shows the researcher FTE increase from 43.38 in 2018 to 49.86 in 2019, staying at 47.87 in 2020.

We would appreciate, if the report on IMCS UL would be reviewed, on the basis of the information provided here, both on the level of the analysis and recommendation formulation and, where appropriate, also with respect to the numerical scores that better characterize our performance, impact, infrastructure and development potential.

Director I.Opmane

Science director K.Čerāns

Feedback received from the Ventspils University of Applied Sciences, Engineering and technology research platform

We are grateful for the experts' constructive comments regarding the assessment, which highlighted our development potential. However, we would also like to provide comments for reconsideration and provide additional facts and explanations.

Overall score: Score 2: adequate level of research

We are slightly surprised that the overall score of our assessment is "2". We believe that we have achieved growth in our research since the previous assessment. Besides, such significant criteria as "Economic impact", "Social impact", "Research environment and infrastructure" and "Development potential" were assessed as "3" ("good").

Assessment criterion "Quality of research"

We cannot fully agree that we are "satisfactory national player". We believe that the quality of our research meets higher level- "The institution is a strong national player with some international recognition. The importance of research by the institution is unquestionable in the experts' assessment. Internationally recognized publishers or journals could publish work of this level".

As experts have noticed and noted in section "Potential to offer doctoral studies", although we don't have our own PhD program, many of our BS and MS students continue their studies in doctoral programs in other universities (University of Latvia, Riga Technical University, others). During these studies they continue their research activities in VUAS. We have successful support activities for PhD students, for example, a special scholarship awarded by Ventspils City Council for PhD studies and for the development of a doctoral thesis. The aim of this scholarship is to attract the PhD students to VUAS and to allow them to defend their dissertations faster in order to start a full-time research career in VUAS. The PhD students are supported and supervised also by their senior colleagues.

Discussions and activities regarding the doctoral study programme in engineering and technologies started already in 2015/2016. First it was decided to create our own doctoral programme however, according to the suggestions from the Ministry of Education and Science in 2017/2018 cooperation on the joint doctoral study programme in technologies, engineering and management was initiated with Riga Technical University. Definite action plan and structure of the programme was designed and necessary human resources were allocated. The programme was planned to establish within the project "Reducing the fragmentation of study programmes and strengthening resource sharing". The development of this PhD program has been delayed due to changes in project implementation regulation. In order to establish its own PhD program, VUAS has to cooperate with some of large universities and this cooperation is already in the process. In 2020, a cooperation agreement was concluded with the University of Latvia. At the same time we continue to employ PhD students from other universities, as this model has proved successful. We are participating in the large international organizations such as EVN, JIV-ERIC, ILT, which could be very useful for practice, training and research of PhD students, young scientists and postdocs. Now the Opticon RadioNet Pilot (ORP) consortium is in the process and it will be the great opportunity for further development of joint PhD programs.

We would like to emphasize that, although we are evaluated by criteria of Western universities, insufficient state support and funding hinders the achievement of these

criteria. The lack of financing is one of the main reasons why many researchers and PhD students spend a significant amount of time teaching BS and MS courses instead of research activities. However, we cannot fully agree that scientific quality suffers from that.
For PhD students, a relatively large workload is not only useful, but it has been specially selected to be very closely related to their research and dissertation topics. For example, Romass Pauliks, as a PhD student, taught several courses closely related to his PhD dissertation topic. Training courses - "Video and sound transmission technologies, Communication network technologies", PhD topic: "Research of video transmission service quality in packet networks". All publications created during the study were closely related to both the training courses and the PhD topic.
Raita Rollande, who defended doctoral dissertation in 2015, also performed research on a similar topic as her thesis. PhD topic: "The Research and Implementation of Personalized Study Planning as a Component of Pedagogical Module", publications: "Raita Rollande, Janis Grundspenkis. Personalized Planning of Study Course Structure Using Concept Maps and Their Analysis, Procedia Computer Science. Volume 104, 1 2017, Pages 152-159, web of Science", "Rollande, R., Grundspenkis, J., Study Course Structure Personalized Planning Using Concept Maps. CEUR Workshop Proceedings, Volume 1684, 2016, 15th International Conference on Perspectives in Business Informatics Research, 4th International Workshop on Intelligent Educational Systems, Technology-enhanced Learning and Technology Transfer Models (INTEL-EDU 2016), September 14-16, 2016, Prague, Czech Republic. Scopus", "Rollande, R., Grundspenkis, J., Mislevics, Suitability Analysis of Graph Visualization Algorithms for Personalized Study Planning. 20th International Conference on System Theory, Control and Computing (ICSTCC 2016), October 13-15, 2016, Sinaia, Romania. Scopus, WoS" and others. Training courses: "Analysis and modeling of information systems", "Programming tools and environments", "Object-oriented modeling".

Assessment criterion "Research environment and infrastructure"

We cannot agree with some statements under section "Research environment and infrastructure" and the subsequent score in this category.

The research facilities operated by VIRAC at VUAS, specifically the 32 m and 16 m radio telescopes, are not only unique infrastructure in the Baltic countries, they are of international importance as they are a key part of European Very Long Baseline Interferometry Network (EVN) and are used for cutting edge international VLBI research (like participating in observations of repeating Fast Radio Burst (FRB) in a spiral galaxy similar to our own, https://www.jive.eu/repeating-fast-radio-burst-spiral-galaxy-deepens-mystery-where-these-signals-originate, and others), moreover, during the evaluation period a full-scale modernisation with investing up to 8 million euros under project „(ICSP-CENTRE) Development of National research centre of information, communication and signal processing technologies" has been carried out with main phases finished in 2016, including full refurbishment of RT-32 antenna system, completely new antenna system for RT-16, state-of-the-art antenna drive and control systems for both radio telescopes as well as upgrades, tools and equipment for laboratories and workshops. This is also the year when EVN board meeting was held on-location (2016) with the main point in agenda to welcome VIRAC as associate member of EVN, however, the EVN

board was so impressed with the upgrades and quality of VIRAC's research infrastructure that they decided to include VIRAC in EVN network directly as full member proving the quality and international importance of this research facility and making the claim that "much funding is needed to modernise such expensive infrastructure" obsolete at the moment. Additionally, some further upgrades currently in progress (like development of microwave holography system for radio telescope RF surface alignment and extending the receiver cabin to house multiple sets of receivers at secondary focus of the antenna system) were presented to the experts. We emphasize that funding for these upgrades is already secured, the projects are on-going and they are inline to make VIRAC facilities outstanding in EU and globally rather than to reach international level.

Additionally, VIRAC has in its disposal RF test and simulation equipment, electronics, cryogenics and mechanical workshops allowing the VIRAC researchers and engineers to carry out research and development for highly specialized and tailor-made receiver systems for both Single Station mode radio astronomy observations as well as EVN suitable VLBI research and for satellite communications which can be tried and tested directly on VIRAC's state-of-the-art radio telescopes. Providing engineering and technology research opportunities both to senior researchers and PhD students.

It is true that this type of infrastructure needs to be maintained to be used in future research and that it is an important national question, this statement applies and is true in case of all institutions operating similar infrastructure.

Feedback received from RTU Faculty of Civil Engineering

RIGA TECHNICAL UNIVERSITY
Faculty of Civil Engineering
Faculty of Civil Engineering, 6B/6A Kipsalas Street, Riga, LV-1048
Phone: +371 67089112, e-mail: bif@rtu.lv

To the Expert Panel

Riga Technical University
Faculty of Civil Engineering

Thank you for your evaluation report and given scores. Your recommendations and overall score for FCE: "3 - good level of research". This is adequate in such a complex direction of civil engineering.

However, there are certain positions on which we would not like to agree, about score 2 (adequate) in criteria research environment and infrastructure. The current situation at FCE is not straightforward due to the complex refurbishment of our building and the fact that the scientific units are divided between different temporary buildings. Returning to normal, we will look much stronger. Currently, due to repairs, several equipment has been dismantled or packed in boxes and cannot be accessed due to reconstruction. Now, in addition to the equipment we use, we can showcase with photos until the repairs are completed. Unfortunately, due to the ongoing repairs, we were unable to fully demonstrate our equipment. The available equipment was filmed in a video format that was available to you. However, much remained behind the scenes, including the use of the equipment in field conditions. Now we add several photo fixations; see annex on 10 pages. . It may not have been noticed and evaluated before.

It would be very great that based on all the above, you could change your rating in this separate position from adequate (2) to good (3).

We are enthusiasts in our field and look to the future with confidence. The specific recommendations you provide will be implemented and we will show excellent results in the next rounds of evaluation.

Dr.sc.ing. Janis Kaminskis
Vice-Dean for Research and Science
Faculty of Civil Engineering

Riga, 24.02.2021.

Feedback received from RTU faculty of Mechanical Engineering, Transport and Aeronautics

RIGA TECHNICAL UNIVERSITY
Faculty of Mechanical Engineering, Transport and Aeronautics

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To Expert panel

Riga Technical University
Faculty of Mechanical Engineering, Transport and Aeronautics

On behalf of the faculty, I would like to thank the panel experts for their work and time in evaluating our faculty as a scientific institution. Your assessment is a valuable opinion that we will use to continue to improve our scientific and research activities.
However, it should be noted that the assessment received has caused a number of questions. With this letter we would like to express the opinion of the Faculty of Mechanical Engineering, Transport and Aeronautics on Panel E1: Engineering and Technology E10 assessment of the institution.

Institution data

Field "Chemical engineering" is erroneously included in the "Corresponding fields of science": it had not been indicated in the self-assessment report.

Expert panel evaluation

The report does not explain why experts had not used ordinary rounding rules for calculation of the overall scores (average 2,5 gives 3 when rounding). Did experts apply any weights to various criteria? If so, which of the criteria were the most relevant?

Overall score
Score: 2 – adequate level of research

Could panel experts clarify the areas they consider at the good research level?
Does "adaption" mean "adaptation"?
It is not clear from the explanation what kind of adaptation is meant - structural changes, process changes or personnel changes. During the visit, the panel experts were informed about

- the structural changes (merging institutes and departments, eliminating inefficient structural units, creating new laboratories with new research directions),
- the changes in institute management (at that time there were two new institute directors),
- the infrastructure development: the faculty has moved to new premises, being physically closer to other university departments.

Concerning structural changes, the faculty would like to note, that in the evaluation period (2013 – 2018) it reduced number of structural unit from 7 to 4, hereby concentrating resources and reducing fragmentation of the research.
From 14 laboratories, mentioned in self-evaluation report p.1.13, two were established in the evaluation period (Mitotoyo metrology laboratory, Bosh Automotive laboratory), while other were significantly modernised during FMETA transfer to Kipsala campus.
The opinion of the faculty is that FMETA is able to adapt to the changes indicated by the structural changes. This is confirmed by the positive dynamics of indicators, by the opening of

new scientific laboratories that have been able to attract funding, the introduction of the latest technologies, etc.
The faculty would like to clarify, whether panel expert consider current funding situation of FMETA as a faculty drawback. To the faculty opinion, the lack of both non- competitive (so called base financing) and competitive state funding should not be considered as faculty fault. In addition, present funding indicators are neither the lowest at RTU nor are they significantly lower than average RTU indicators: the average financing per one FTE at RTU is 128,8 thousand EUR, at FMETA is 125,6 thousand EUR, that is just by 3,2 thousand EUR less.
The faculty believes that despite the panel's reprimands and concerns about low funding, the relatively high assessment of Social impact, Research environment and Development potential confirms the faculty's ability to adapt and operate successfully despite low public funding.

Quality of Research
Score 2: adequate

Could panel experts clarify what is the accurate number of researchers that they are considered as being key investigators: it is not clear, how many such key investigators would be sufficient to establish FMETA as a well – recognised international player, bearing in mind that those researchers actually lead teams of less skilled researchers.
Faculty would like to clarify, why Self – assessment report p.1.1 does not provide detailed insight into a future technological and scientific research goals. Following the self-assessment report form, in the p.1.1 FMETA had to describe its strategic, long-term research goals – and it has been done according to strategic research goals of the RTU (see RTU strategy), not for each FMETA research direction
Still, self - assessment report mentioned that FMETA employed new research personnel to develop new research directions:
 Sport technology researchers (PhD student J. Lungevics) in cooperation with Latvian sport federations generates technological solutions, enabling Latvian athletes achieve higher results.
 Research on multifunctional composite materials (Dr.ing. J. Pupurs), adding extra thermal, electrical, magnetic properties;
 Single cell lab on chip technology (Dr.med U. Berzins) – development of single – cell microfluidic device.
The faculty agrees that the main fault of the faculty is the lack of participation in the Horizon 2020. This was acknowledged during the meeting with platform experts and declared as a future goal. Alongside, please, note that self-evaluation report mentioned participation of several faculty staff members in Horizon 2020 projects: ARIES project (RTU budget ~ 0.53M EUR) and COST TD1305 IPROMEDAI project (p. 16)
The evaluation does not mention an indicator of research quality such as the number of European patents, which is one of the largest in the university.
Generally, the number of reported outputs per FTE is not the lowest among other RTU faculties (12,37, while 10,63 is the lowest)
FMETA could use the framework for sabbatical leave, established at RTU, although one could admit, this program has not been intensively used yet.
One could additionally comment that papers, listed in the self-assessment report p.3.3, was not selected on the base of highest FWCI. The papers were selected mostly due to impact they had on the FMETA scientific activity, e.g. relation to FMETA projects, development of new research fields etc. For example, the self – assessment report does not include such publications as

- Zemite, L., Gorobecs, M., Smats, A., Jasevics, A., Levchenkovs, A. Genetic algorithm for optimization of power switch allocation in distribution network, EEEIC / I and CPS Europe, 2017, FWCI 9.16
- Auzins, J., Janushevskis, A., Janushevskis, J., Skukis, E. , Software EDAOpt for experimental design, analysis and multiobjective robust optimization, OPT-i 2014 - 1st International Conference on Engineering and Applied Sciences Optimization, Proceedings, 2014, FWCI 6.61

- Viba, J., Eiduks, M., Irbe, M., Double pendulum vibration motion in fluid flow, Engineering for Rural Development, 2015, FWCI 4.75
- Eizentals, P., Katashev, A., Okss, A., Pavare, Z., Balcuna, D., Detection of excessive pronation and supination for walking and running gait with smart socks, (2018) IFMBE Proceedings, 68 (2), pp. 603-607., FWCI 4.28
- Bulaha, N., Rudzitis, J. Analysis of model and anisotropy of surface with irregular roughness, Engineering for Rural Development, 2017, FWCI 3.87

As the number of indicated international collaborating scientists / institutions was limited in the self – assessment report form (15 persons and 30 institutions, correspondingly), the faculty is afraid it could lead to the panel expert conclusion about a weak documentation of cooperation with the international academic or industrial community.

Impact on the scientific discipline
Score 2: adequate

FMETA indeed has the lowest figure of number of WoS and Scoups publications per FTE in the University (6.81). But the number of patents per FTE is the highest in the University (0.79), that indicates that FMETA is more directed to the applied research and development.
Although individual researches can be considered fragmentary (no justification in evaluation), the research, conducted at the faculty are generally complementary, with a possible exception of the research in the field of biomedical engineering.
The panel experts report does not quantify what number of internationally recognized scientists would be needed for the faculty to receive a higher evaluation, because as already mentioned in the panel evaluation, there are such researchers in the faculty.
The funding model for doctoral studies is determined by the state – level framework. During the visit, the panel experts were informed that a new doctoral model is currently being developed in Latvia, The model initially will be implemented as a project, but in future it gives a perspective for sustainable financing of PhD studies and PhD - based research. Panel experts were also informed about the funding tools available to existing doctoral students. During the visit, the panel experts met with doctoral students and post-doctoral researchers, of whom only one PhD student worked outside RTU. For the rest, local and foreign doctoral students received grants. One could add, that the number of PhD students per researcher in 2013 – 2018 was second biggest in the University (0.74, while the biggest one was 0.87).
Panel experts seem to have a misconception about the workload of researchers at the university. Most researchers at the university perform a variety of duties, e.g. are involved in teaching, so they receive remuneration from a variety of funding sources. If only the researcher's workload, financed from science / research funding sources, is assessed, then the impression that most researchers are part-time employees could appear. This, in fact, does not reflect the real workload of these employees at the university.

Economic impact
Score 2: adequate

The faculty has an opinion, that evaluation of the direct economic impact via amount of the private funding may be misleading. The cooperation with companies often is organised via student's graduation thesis – e.g in biomedical engineering field, annually up to 40% of the bachelor thesis are developed to meet the needs of Latvian companies.
The panel experts may not be aware on the situation of Latvia's R&D and the situation in the global context. Page 50 of the report "Global Innovation Index 2018" (https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2018.pdf) is a clear indication that in the assessment period (2013-2018), Latvia's R&D investments experienced a fall, which also reflects low levels of private sector investment in general.
There are 108,160 companies registered in Latvia, which employ less than 50 employees and which in 2019 (the structure of companies did not differ much in the period 2013-2018) had a turnover of less than 10 million euros or whose total balance sheet value was less than 10 million

euros. According to the definition of the European Commission regulation, these enterprises are classified as micro and small enterprises. Compared to the total number of active companies registered in Latvia, small business makes up the largest part or 98.65% of all companies, Lursoft (state-maintained information system on companies) concluded.

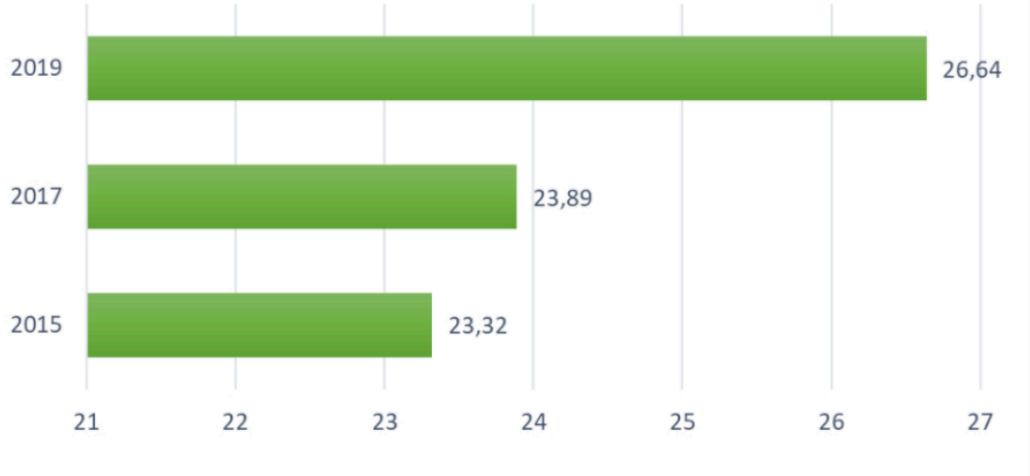

Fig.1 Dynamics of the total turnover of small business enterprises in Latvia, billion euros

Generally, the funding received by the faculty per one researcher FTE is not the lowest in RTU, as well as it does not lag significantly behind the funding of the faculties that have received a rating in this indicator 4 (see comment to the overall score explanation).
FMETA is one of the largest players at the RTU for providing international level education on all levels. Approximate annual revenues from tuition fees of international students of FMETA exceeds 1.1 Million EUR.

Social impact
Score 3: good

The explanation states that the cooperation is good and the number of publications is reasonable, so it is not clear why the rating is not higher. It is not specified how many publications per researcher would be considered a very good indicator.
It is not clear what indicator in self – assessment report demonstrated, that cooperation and visits with the public sector are restricted.

Research environment and infrastructure
Score 3: good

One should note that self-assessment report provides description of the FMETA research strategy (p.1.11), that was developed in accord with the general RTU research strategy. This strategy set number of goals and indicators for the next 6-year period. Nevertheless, FMETA never pretend to develop common research agenda for all FMETA research groups, as it is, with a due respect to the academic freedom, in the competence of the research groups itself.

Development potential
Score 3: good
Potential to offer doctoral studies

The drawbacks, mentioned in the above section, are out of the competence of FMETA. The faculty could not override university rules for involvement of international PhD students. The

faculty opinion is that drawbacks of PhD financing model and international PhD students involving mechanism could not be considered as FMETA drawbacks.
Seems, that panel experts were misinformed about supervision of PhD students. PhD students have annual intermediate assessment with a clearly established criteria, set by the RTU PhD study department. The faculty implements general RTU requirements for PhD assessment by default.
As for international PhD students, RTU and FMETA in particular have fast growing number of international PhD students – during the academic year 2019-2020 the number of International PhD students at the RTU increased for 40 per cent. Admission of international PhD students is centralised, organized by the Department of International Cooperation and Studies in close coordination with RTU faculties and RTU Doctoral School. RTU has strong development plan to attract larger number of international PhD students based on its own resources, mostly due to the fact that support by State Agency of Education Development (VIAA) providing state scholarships for PhD students has not been significant in technological fields. In 2019-2020 Riga TU started funding program DAD which provides full scholarships for PhD students, many of them are in FMETA. DAD scholarships cover 4-year period of doctoral studies, covers business trips and conference fees. At present FMETA has 9 international Doctoral students from India, Russia, Egypt and countries of Central Asia. Continuation of DAD for a student is dependent from annual assessment by the faculty and Doctoral School. In summer 2021 similar RTU scholarship program DAD2 will be launched with specific initiative to encourage RTU international Master students to continue their research and studies on a doctoral level.

Riga, 24.02.2021.

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