

March 2026

International Evaluation of Scientific Institutions Activity Panel Report: Engineering and Technologies

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Abbreviations

AI	Artificial Intelligence
CERN	European Organisation for Nuclear Research
CERT.LV	Cyber Incident Response Institution
COST	European Cooperation in Science and Technology
CVS	Cryogenic and Vacuum Systems Ltd
E ³ UDRES ²	Entrepreneurship and Innovation Network for Smart and Sustainable European Regions
EDI	Electronics and Computer Science
ERA	European Research Area
ERA-Net	European Research Area - Network
ERASMUS	European Community Action Scheme for the Mobility of University Students
ERC	European Research Council
FCME	Faculty of Civil and Mechanical Engineering
FCSITE	Faculty of Computer Science, Information Technology and Energy
FTE	Full Time Equivalent
FWCI	Field Weighted Citation Impact
HCP10	Highly cited papers 10%
HPC	High-Performance Computing
ICT	Information and communication technologies
LBTU	Latvia University of Life Sciences and Technologies
LMA	Latvian Maritime Academy
MDPI	Multidisciplinary Digital Publishing Institute
MSCA	Marie Skłodowska-Curie, Actions
NST	Natural Sciences and Technology
RAI	Riga Aeronautical Institute
RIS3	Research and Innovation Strategy for Smart Specialisation
RTU	Riga Technical University
SME	Small and medium-sized enterprise
STEM	Science, Technology Engineering, and Mathematics
TRL	Technological Readiness Level
TSI	Transport and Telecommunication Institute
UL	University of Latvia
ViA	Vidzeme University of Applied Sciences
WoS	Web of Science

1 Introduction

International Evaluation of Scientific Institutions Activity analysed the research performance and international competitiveness, considering also the socio-economic impact and development potential of the units. Results of the evaluation can serve as input in policy making and will enable the units to improve their performance based on the recommendations.

The Engineering and Technologies panel evaluated twelve units:

- Rezekne Academy of Riga Technical University
- Vidzeme University of Applied Sciences - Study and research field of engineering and technologies
- Latvia University of Life Sciences and Technologies/ Engineering and technology
- "Institute of Mathematics and Computer Science, University of Latvia"
- Institute of Electronics and Computer Science
- CRYOGENIC AND VACUUM SYSTEMS Ltd
- Riga Technical University Faculty of Civil and Mechanical Engineering
- "Riga Technical University Faculty of Computer Science, Information Technology and Energy"
- Riga Technical University Faculty of Natural Sciences and Technology
- Latvian Maritime Academy of Riga Technical University
- Transport and Telecommunication Institute
- Riga Aeronautical Institute

The Expert Group evaluated the units 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 unit involved a documentary review and the Expert Groups' visit to the units. The final evaluation of each unit is a collective view of the Expert Group.

The analysis of each unit by the Expert Group is presented in the following sections.

Feedback on the Expert Group assessment received from the units is published in Appendix A.

2 Institution reports

E_1 Rezekne Academy of Riga Technical University

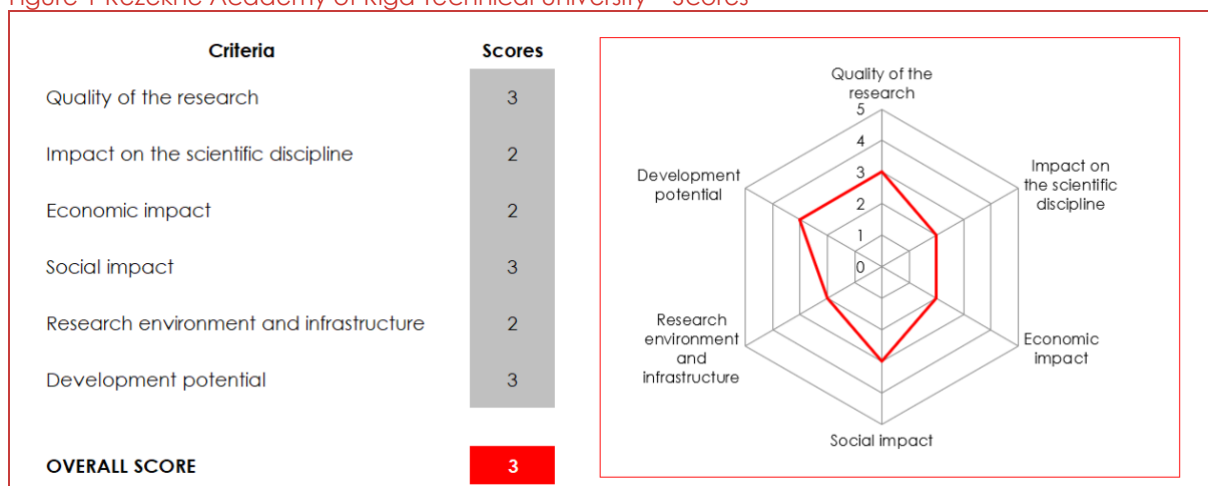
2.2.1 The unit

The Rezekne Academy of Riga Technical University (RTU Rezekne) is a higher education institution focused on engineering and technology, as well as social sciences. It was consolidated with Riga Technical University in 2025. The evaluation covers the activities of Rezekne Academy of Technologies (RTA) from 2019 to 2024. The mission of RTU Rezekne is to contribute to sustainable societal development through high-quality education, research, and innovation, with a strategic focus on the Latgale region in Eastern Latvia. The unit aims to integrate into Latvian and European higher education and research, fostering innovation in traditional economic sectors and creative industries. Research at RTU Rezekne is organised around three main faculties: Faculty of Engineering, Faculty of Economics and Management, Faculty of Education, Languages and Design. These faculties are supported by specialised research institutes focusing on engineering, business and social processes, and regional studies. Key research areas of the unit include laser technology, artificial intelligence, non-thermal plasma, regional development, sustainability, and digital humanities.

2.2.2 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 1 Rezekne Academy of Riga Technical University – Scores



Overall score

Score 3: good level of research

The Expert Group allocates the RTU Rezekne an overall score of '3', recognising a good level of research quality. The research focuses, engineering and technology, and business and social sciences are distinct. The engineering and technology cover laser technology, ICT (e.g., AI-driven research), and non-thermal plasma, while the social sciences range from sustainability, education, and tourism to cultural heritage research. In the self-assessment report, data related to the productivity of these directions is not disaggregated. However, the unit's AI-driven research effectively addresses interdisciplinary and multidisciplinary challenges, contributing meaningfully to regional sustainability with some international recognition. In general, the research of RTU Rezekne is at a good level. The impact related to social sciences is especially strong, reflecting the relevance and applicability of its research outcomes. The research infrastructure is at an adequate national level. Further, the unit shows promising potential to

develop and offer doctoral studies, capabilities expected to be strengthened further through its merger with RTU.

Quality of Research

Score 3: good

The Expert Group scores the unit's research quality as recognising it as a good national player with emerging international visibility. Historically, the unit encompassed three disciplines, now consolidated into two – engineering and social sciences – each diverse in scope. The unit's strengths lie particularly in social sciences and selected engineering fields.

The quality of social science research is good, especially in the field of education, with high-impact journal publications (e.g., the Journal of Multilingual and Multicultural Development and Education Sciences). Another example of high-quality research is the integration of AI-driven solutions and models for a zero-waste economy, developed for school catering. The recognised research in laser technology reflects the good quality of engineering research overall, further evidenced by notable publications in non-thermal plasma and research on AI. The related publications are at an international level. Data for these research fields is currently not broken down into distinct categories, making it difficult to clearly evaluate the contribution of each scientific field, except in the case of AI-driven research.

The self-assessment report highlights two main weaknesses: challenges to attracting both high-quality and early-career researchers, and limited experience in managing international projects. Despite these challenges, the unit has shown progress during the evaluation period. Competitively secured research funding, and the number of publications in good journals has increased to some extent. Moreover, there is solid evidence of active international collaboration, including growing engagement beyond national borders, including, for instance, Riga Technical University, Vidzeme University of Applied Sciences, Ecoistituto del Friuli Venezia Giulia (Italy), Mercator European Research Centre on Multilingualism and Language Learning, and Technical University of Gabrovo (Bulgaria).

Impact on scientific discipline

Score 2: adequate

The Expert Group scores the impact of the scientific discipline as adequate, recognising the unit's stable position within the national community. Its international standing is still developing, with some promising signs of growth. The unit's journal articles are published in international journals of general impact (mainly Q2), apart from some publications in the field of education science. The impact of social sciences can be seen in their role for the national scientific community (joint PhD programmes with other Latvian universities, Rezekne city schools and Latgale Tourism Association), participation in some international conferences (e.g., 16th International Conference of Education, Research and Innovation), and a large number of editorial memberships (e.g., Worldwide Hospitality and Tourism Themes). Social sciences also have a leading role in Baltic linguistics, language policy, and ethnolinguistic studies. The impact of engineering and technology includes an important action on opening the Laser Centre. It has been able to create collaboration with the European Space Agency (project started in 2024) and international partners (Erasmus +), with modest activities within conferences and editorial duties. Both fields have been able to create relatively wide international and national collaboration, including recognised institutes like Wageningen University & Research (Engineering and Technology), Trinity College Dublin (Economics), and the University of Ontario (Education).

Research outcomes in certain areas – particularly education – have the potential to make significant scientific contributions. In addition, other technological domains, AI-driven research addressing multidisciplinary challenges, are likely to support regional sustainability, especially in sectors such as farming, tourism, and precision agriculture. This is reflected in the high

disciplinary diversity of authors. However, the field-weighted citation index of 0.7 remains below the world average (1), indicating room for improvement in the publications' international visibility and overall impact.

Economic impact

Score 2: adequate

The Expert Group allocates the unit's economic impact a score of '2'. The research performed is important to the economy, yet its activities are at a relatively low level. However, the unit demonstrates an increasing level of interactions with the private sector. State funding, from the Investment and Development Agency of Latvia, facilitates research but also enables research contract services. According to the self-assessment report, the unit has received research funding of €4.5m during the evaluation period, but its CAGR is low.

The economic impact of the social sciences appears strong, as evidenced by their competitively won funding to enhance the regional economy. Sources of funding include Erasmus+ for the Digital Skills for Future Supply Chain Management 4.0. National funding, including LCS's Fundamental and Applied Research projects and the State Research Programme, have supported RTA's growth, particularly between 2019 and 2024. It has contributed especially to advancing sustainability and environmental conservation advancing e.g., circular economy practices.

The unit's engineering research has been able to build the important Laser Technology Centre, with ERDF support. It has worked on custom AI tools, e.g., for Vet Health Spektrum Ltd. Another example is cooperation with Bulgarian, German, and Latvian enterprises in the field of laser technology. The outcome with companies in terms of contract research is prototyping, personnel training, and technology transfer. However, the given numbers for these are low, with only 12 non-academic collaborations listed. Also, the number of patents is low, with only one Latvian and one European patent in mechanical engineering for a belt transmission. Collaborating companies are also relatively small and regional.

There is clear room to expand industrial collaboration, especially for the engineering research at the department, and strengthen partnerships with business stakeholders by creating a joint strategy and defined goals. On that basis, national and international projects with selected partners can be created, and the unit could provide open infrastructure and test environments for contract research.

Social impact

Score 3: good

The Expert Group scores the impact of the scientific discipline at '3', recognising the unit's interaction with the public sectors as being at the level expected for recognised academic institutions. The social impact is mainly created within the unit's social sciences. The unit's social impact is particularly evident in its contributions to sustainability, including research on circular-economy practices, waste reduction, and environmental conservation. Its social science research also demonstrates strong societal relevance, especially through work on the Latgalian language, such as the speech technology development project, and cultural heritage initiatives, including multilingualism in collaboration with IMCS. In addition, its educational work supports inclusive digital participation in education and digital pedagogy. Based on RTU Rezekne research, it has developed proposals and recommendations on digital transformation of the education sector in the National Research Programme project "Life with COVID-19: Evaluation of overcoming the coronavirus crisis in Latvia and recommendations for societal resilience in the future". Additionally, it has collaborated with the Latgale Tourism Association, resulting in a methodology for monitoring tourism dynamics, helping policy makers to develop data-driven strategies for sustainable tourism growth.

The unit maintains active collaboration with educational institutes, municipalities, and NGOs, supporting inclusive education, rehabilitation, and digital pedagogy. These partnerships span multiple levels and reflect a commitment to societal development. Efforts to promote public understanding of science and education are primarily regional, involving events such as the MINOX Inventors' Exhibition, Researchers' Night, the "Laikapa" exhibition on Latvia's food history, and national TV debates, which facilitate the transfer of practical knowledge into the regional economy and education. The unit cooperates with Lithuania and Ukraine on socialisation of gender equality, and human capability development, and in the Latvia-Ukraine project on gender aspects of digital readiness and development of human capital in the region.

Research environment and infrastructure

Score 2: adequate

The Expert Group scores the research environment and infrastructure of the unit as being a satisfactory national player. The research infrastructure supporting engineering and technology provides several capabilities. Some of these – such as laser technology (facilities including e.g., CO₂, fiber and Nd:YAG lasers) – have gained international recognition, while others, like non-thermal plasma research (well equipped set-ups with e.g., chromatograph, calorimeter and FTIR analyzers, wide range of design and modelling software like SPSS and COMSO), need further development. Particularly commendable is the unit's ability to integrate ICT tools and training laboratories/workshops across disciplines. There is a reference to a Social Pedagogy and Rehabilitation Technology Laboratory and a Special Educational Laboratory, which are, however, difficult to link to current research programmes, due to their different research directions. In general, research infrastructure in engineering and technology is stronger than in the social sciences. The unit is aware of the limitations within its research environment and infrastructure, such as a low proportion of full-time academic staff and part-time researchers, and a lack of funding for the development of research infrastructure. It has developed a Research Infrastructure Management Plan, which provides strategic guidelines for efficient management, shared use, and coordinated utilisation of the research infrastructure.

Looking ahead, the unit plans to strengthen its research capacity by investing in new equipment, expanding staff through professorships and tenure-track positions, and enhancing PhD training via a new doctoral model. The consolidation project with RTU provides funding for the development of the laboratory base, which will clearly advance the research capabilities of the unit in the future.

Development potential

Score 3: good

The Expert Group scores the development potential of the unit as '3', being able to strengthen its position in the international community over the next 5-10 years. The unit has several research objectives aligned with global scientific trends, and it plans to open/develop new research directions, such as EU projects (including Horizon Europe and the WIDERA calls). However, the unit should concentrate its current strengths and open new locations very carefully. Otherwise, there is the danger of becoming too unfocused.

The recent merger with RTU is expected to significantly enhance the unit's development potential across multiple dimensions, including infrastructure, doctoral supervision, access to a broader international scientific network, and the adoption of best practices. RTU's established visibility and research competitiveness are expected to facilitate wider international collaboration with improved access to funding opportunities, like ERA-NETs. Especially the unit, in addition to its current research funding, aims to increase its participation, e.g., in Horizon Europe and establish the national Research Centre of Applied Laser Technology in Rezekne as a centre of excellence. Moreover, it seems likely that there would be a great potential for

development if social sciences were integrated with other specialities within RTU, such as “Cities and Development” and “Information and Communication.”

Potential to offer doctoral studies

Currently, the completion rate for doctoral students is relatively low. It seems that the main challenges doctoral students face are related to funding. They work part-time on projects or for an NGO. In the on-site interviews with PhD students, it was mentioned that these challenges often lead students to drop out of their studies. Hence, the number of students is relatively small, which means some courses have only a few participants.

However, following the recent merger with RTU, the unit is well positioned to contribute to a broader range of doctoral programmes. This merger provides access to enhanced infrastructure and a wider international research community, which can significantly benefit doctoral students. It is also important that RTU shares its established best practices in doctoral supervision with the unit, thereby strengthening mentoring and academic support. Furthermore, the unit's involvement in long-term Erasmus+ projects, COST Actions, and other international collaborations (e.g., Bulgaria, Poland, Lithuania, Sweden) offers valuable opportunities for PhD students to engage in cross-border research and academic exchange.

Alignment with the Smart Specialisation Strategy

The unit supports the objectives of RIS3 through its several key focus areas. Projects to reduce food waste and introduce a circular economy are in line with the knowledge-intensive bioeconomy, research on laser technology and smart materials, and ICT through, e.g., tourism and farming with information and communication technologies. The unit's social sciences, being partly cross-disciplinary research, contribute to RIS3 by integrating digital humanities, digital pedagogy, and digitisation of cultural heritage, thus fostering knowledge transfer and the digital transformation of society.

Conformity with state scientific and technology development

The unit's scientific activities aligned mainly with the Latvian guidelines for Science, Technology Development, and Innovation Guidelines (2021-2027). It supports the development of pilot innovations in the field of education, farming, digital humanities, tourism, and cultural heritage, mainly at the regional level. Especially, RTU Rezekne's social science research using AI-driven solutions is making a strong contribution to achieving Latvian policy goals. It also contributes to the economy through its support for the Latgalian language. Through its business and economics as well as technology research, the unit also maintains close links with the world of business and with entrepreneurs through joint projects, scientific conferences and public discussions.

Recommendations

- The unit's scientific impact at an international level could be increased through a wider European network and by applying for Horizon funding across different pillars. It is recommended to identify Horizon Europe calls across several pillars - particularly Pillar II (Global Challenges) and Pillar III (Innovative Europe) - that match the unit's strengths in AI-driven research, laser technology, sustainability, education sciences, and regional development.
- Importance for the economy should be expanded significantly at the national or even European level by, e.g., mapping the research strengths, strengthening industrial collaboration (especially with medium-sized companies), and developing a clear and solid narrative of its interdisciplinary science. A strategic mapping of the unit's research strengths - particularly in laser technologies, AI applications, sustainability, cultural heritage

digitisation, and educational innovation - would clarify its unique value proposition for industry and public stakeholders.

- Career planning/opportunities should be developed to attract highly qualified researchers and young talent. The unit has good plans for improving human resource renewal, especially by supporting doctoral students and early-career researchers. However, the Expert Group suggests introducing actions that are specific to more advanced researchers, such as providing start-up packages, providing excellent infrastructure, and helping with family relocation.
- The unit plans to initiate and expand new research directions. However, it should also fully leverage its strong existing collaboration between engineering and social sciences (like existing technologies – e.g., ICT, materials for medicine, robotics and education, sustainability), as well as capitalise on regional opportunities moving forward by providing test environments for collaborative projects.
- The merger with RTU offers benefits on multiple levels, and its full potential should be harnessed by strategically leveraging the strengths of both institutions, e.g., by sharing good practices related to doctoral training or combining the complementary research strengths in a joint (national/EU) project. The merger with RTU offers substantial advantages, including access to stronger research infrastructure, broader academic expertise, and well-established international relationships. To maximise these benefits, structured mechanisms for cooperation should be developed, such as joint doctoral schools, shared laboratory infrastructure, co-supervision schemes, and collaborative research clusters. The creation of joint national or EU-funded projects (e.g., under Horizon Europe, Digital Europe, or ERA Chairs programmes) would allow the unit to capitalise on complementary strengths in engineering technologies, social sciences, and regional development. Sharing RTU's best practices in doctoral training, project management and internationalisation will accelerate the unit's long-term competitiveness.

E_2 Vidzeme University of Applied Sciences - Study and research field of engineering and technologies

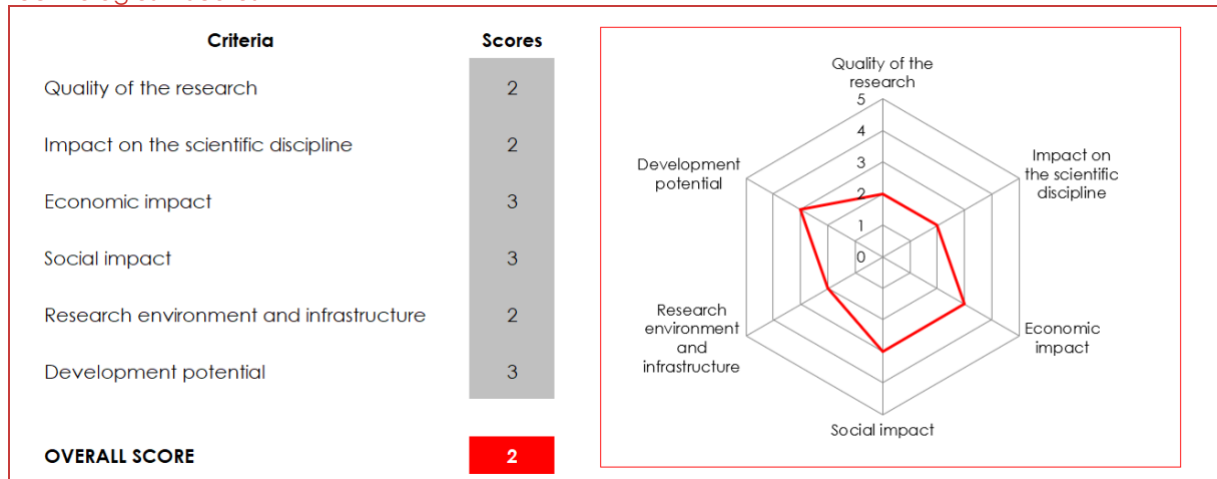
2.2.3 The unit

The Vidzeme University of Applied Sciences (ViA) is a university of applied sciences located in Valmiera. The university's mission is to conduct excellent interdisciplinary research that addresses social issues in both international and regional contexts. The university collaborates with local stakeholders to address regional needs through its study and research programmes and has a strong regional focus, on the Vidzeme region. Research at the Socio-technical Systems Engineering Institute (SSII) at ViA is organised around several main themes that are thematically aligned with the study fields the unit offers. These include Information Technologies, Cybersecurity, Virtual Reality and Smart technology, and Socio-technical Systems Engineering.

2.2.4 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 2 Vidzeme University of Applied Sciences - Study and research field of engineering and technologies – Scores



Overall score

Score 2: adequate level of research

The Expert Group awards the Socio-technical Systems Engineering Institute (SSII) of Vidzeme University of Applied Sciences an overall score of '2', indicating an adequate level of research. The unit focuses on applied research with a high Technological Readiness Level (TRL). Typically, the research addresses Information and Communications Technology and Virtual Reality solutions for sustainable construction, e-learning, healthcare, and security. The quality and impact of some research directions are more advanced than others, but are generally regarded by the Expert Group to be at an adequate level. The position of the unit within the international scientific community is still evolving, but it shows a rather good level of cooperation internationally through joint projects, which has also enabled industrial collaboration. The E³UDRES² network forms the backbone of the unit's international dimension and strategic planning. But the unit also maintains active networks with institutions in Baltic countries, across Europe, and beyond, thriving on joint research projects, staff exchange, and engagement in policymaking. This includes, for example, data science and machine learning collaboration with RTU High Performance Computing and the Braude College of Engineering in Israel. ViA actively participates, within its available resources, in other important

partner-country initiatives such as editorial boards of scientific journals, associations, networks, project consortia, and award initiatives.

The research of the unit is important for the economy and society, especially on a national level. The unit demonstrates interaction with the private sector, notably in the form of contract work and developing prototypes, as well as with social stakeholders, for instance, in projects related to digital health. The research infrastructure is still developing, and the unit has access to its collaborators' facilities (e.g., Latvian SIA Latvijas Mobilais Telefons, RTU, Valmiera County municipality, Vidzeme Planning Region).

The number of defended doctoral theses is low. However, the potential to offer doctoral studies and overall development is strong, given the actions already underway and those planned (e.g., doctoral study positions are to be offered as job vacancies with integrated career planning).

Quality of Research

Score 2: adequate

The Expert Group scores the quality of the research as '2,' which is adequate. The unit has strong research collaboration at the regional level, including public research institutes, enterprises, and sectoral public partners. In most cases, its research is closely related to regional needs. The unit has also been building an international network, particularly through the E³UDRES² framework and other joint research actions. However, this network is still evolving.

Importantly, the international partners are not limited to regional actors, which strongly supports ViA's smart specialisation strategy (S3) without undermining regional partnerships. To date, the unit's research has been funded through national sources (VPP, FLPP), Horizon 2020, Horizon Europe, the Baltic Programme of the EEA Financial Mechanism, ERDF, Creative Europe, and several additional projects. This demonstrates the progress achieved during the reporting period. The project list is good, but ViA should increase its ambition by applying for funding using Horizon pillars. It is well-known that this competition is hard, but this would strengthen its research capabilities and infrastructure.

The unit is doing relatively well in the research fields of wireless sensors, mixed reality and feedback with EMG analysis related to deep core exercising, and a statistical predictive model to identify diabetes emergencies that are published in international journals. Other papers listed in the self-assessment report relate to, e.g., teaching/learning, mathematical models of photons, sensor networks, virtual reality, farming, and agriculture, and smart cities. The unit's FWCI is below the world average of 1, and the share of publications in Q1 journals is 17.2%, indicating potential to improve its impact in the field.

The unit is relatively small, with 23 researchers trying to cover many different research fields, which is not an effective approach. Also, only a few researchers stood out as being highly active. The main strategic document governing research activity at ViA, "Scientific Development Plan 2024-2030," which is a thematic derivative of ViA's Development Strategy 2023-2028, has been elaborated. It lists goals related to quality of science, doctoral education, administration, human resources, etc. It is partly built on the E³UDRES² network, and many of the activities are only planned for the future. ViA has been able to increase the amount of funding it attracted annually in 2019-2024 to €84.5k per FTE. This demonstrates its general competitiveness on an international level. Future plans should be further developed with a clarified identity of the unit.

Impact on scientific discipline

Score 2: adequate

The Expert Group scores the impact on the science discipline as '2' since the unit occupies a stable position in the national scientific community. The European University Alliance E³UDRES² is one of the backbone elements of the unit's international dimension. Within this alliance, the unit aims to promote regional development, apply research funding, and strengthen doctoral studies, which have been realised concretely by establishing the Doctoral School and funding joint projects also with enterprises as partners. The unit has developed a network of cooperation partners for using the external infrastructure and having access to their data banks and material collections.

The research on the identification of diabetes emergencies and the analysis of deep core exercises is of good quality, and the results are published in international journals. However, most other publications indicate only a merely adequate level of scientific impact. This results in a low level of citations and limited visibility for the unit's research. The number of Q1/Q2-level publications has increased during this evaluation period, but the field-weighted citation index remains low (0,64), as several high-level publications were published at the end of the evaluation period.

Economic impact

Score 3: good

The Expert Group scores the economic impact as '3', being at a satisfactory level of interaction with the non-academic and private sector. The unit has been able to attract a substantial number of contract works commissioned by local and national SMEs and some larger national companies, which yield, in addition to technological advancement, also contributions to sustainable economic development. For example, the unit has developed prototypes for a fully digitised mobile underfloor heating system equipped with sensors, and a mobile application for functional assessment of children's posture. However, no patents were listed, but postdoctoral research projects have created two spin-offs (ACR4edy Ltd., and RehaHIT Ltd.). Some consortium projects have industrial partners (e.g., Ted4Lat has an SME as a living-lab partner). In the interview, the representatives from industry (e.g., Latvian SIA Latvijas Mobilais Telefons and Exonicus Inc.) expressed satisfaction with the collaboration and the obtained results.

Social impact

Score 3: good

The Expert Group scores the social impact as '3', indicating interaction with the public sector/public at the level expected of a recognised academic institute. Public health is addressed in several digital health-related research projects, involving, e.g., rehabilitation and smart textile solutions. An important social impact of the unit is also created in joint projects like Interactive Gardens and H2-SEAS.

The unit has several sectoral public partners strengthening its regional aspects, like Valmiera County municipality, Vidzeme Planning Region, and Investment and Development Agency of Latvia, which reports publications, science community activities, prototypes, etc., as outcomes.

The unit is very active in demonstrating research importance and results to the public, including participating in the European Researchers' Night, the TV programme "Science in Close up" hosted on the National TV Channel ReTV, podcasts, and videos, among other related activities with schools and students.

Research environment and infrastructure

Score 2: adequate

The Expert Group scores the research environment and infrastructure as '2', being at an adequate level. In addition to research offices, the unit has recently invested in laboratories devoted to Virtual Reality, Multimedia, RFID engineering, Electrical engineering, Computer network, Mechatronics, and Construction. These are mostly laboratories suitable for education but also constitute an integral component of the institution's research infrastructure. The level of the actual research infrastructure still needs development, as also mentioned in the SWOT. To strengthen its capabilities, the unit has, together with E³UDRES², developed a strategic and long-term development plan (ViA Real Estate Development Plan, 2024-2028). The unit has developed a network of cooperation partners to facilitate access and use of external research infrastructures. However, the practical organisation of this approach is unclear; for example, coordination for access and access procedures is not clear, shared investments are not outlined, and there is no evidence of joint training programmes.

The unit is small in size; it has a very limited number of doctoral graduates. Only 1.14 doctoral students were reported in 2024 and 2.28 in 2023. There are not enough senior-level researchers, which limits the possibilities to develop research infrastructure and environment. To tackle this challenge, the unit has created a Development Strategy (2023-2029) that includes an academic career model for human resource development and attracting young researchers, as well as the implementation of open science principles. During the evaluation period, it has also demonstrated steady progress in key indicators related to funding the unit attracted, an increase in FTE for scientific workload, an improvement in publication quality and environment. Also, VIA's new PhD Programme is implemented with international partners.

Development potential

Score 3: good

The Expert Group scores the development potential as '3' with the potential of becoming an international player in the future. The unit underscores its contribution to regional advancements through innovation and knowledge transfer. An important part of this strategy is the established European University Alliance E³UDRES² with nine regionally based universities in different EU countries. As the unit is small and perhaps has an undercritical mass by itself, this is a reasonable strategy. Within this alliance, the unit has several other strategic plans/documents for the development of the unit at many levels, including human resources, infrastructure, and open-science policy.

The unit already has some developing research fields and a relatively good national and an emerging international network. It has been able to collect a good amount of funding: €6.1m from competitive research projects and €1.3m from infrastructure and institution development projects, with several joint scientific/applied projects. Additionally, its administration was merged to consolidate administrative resources and involve professional help to enhance the success of grant applications. Overall, the SWOT analysis is realistic and identifies actions within its power.

Potential to offer doctoral studies

The PhD programme is run in collaboration with the RTU Rezekne, which was merged with the Riga Technical University on 1 April 2025. VIA's new PhD programme in this field is already being implemented in a different format with international partners and is transitioning toward a focus on producing doctoral degree holders needed in industry.

The number of defended doctoral theses is low to date. Five individuals have defended their doctoral theses between 2019 and 2024. A new Doctoral School was launched in 2024, including the existing doctoral programmes. This initiative aims to accelerate graduation

timelines and attract junior researcher staff. As part of this effort, doctoral study positions are to be offered as job vacancies with integrated career planning. However, the unit still has limited experience in supervising PhD graduates, and its capabilities should be strengthened.

Alignment with the Smart Specialisation Strategy

The work of the unit lies within the area of "Information and Communication Technologies," with its solutions extending to cross-disciplinary applications in fields such as biomedicine, medical technologies, and pharmacy. In alignment with the RIS3, the unit emphasises five industrial contract projects for different companies (e.g., VireTS to render infrastructure and streaming services, Z-Triton to research DIY technology and material sample development, CarMonitor system development, a mobile application for functional assessment of children's posture (for Minku Ltd.), and mobile underfloor heating system) that have delivered innovative solutions with economic impact.

Conformity with state scientific and technology development

The unit covers relatively well the focus of the Latvian guidelines for Science, Technology Development, and Innovation 2021-2027. It undertakes various initiatives to foster innovation, promote excellence in scientific outreach, and ensure efficient R&D development.

In general, the unit has a limited number of personnel and new doctoral students, but it plans to continue balancing fundamental and applied research to provide career opportunities to established, emerging, and new researchers. The collaboration with industry is at a sufficient level, and the unit plans to strengthen it through new projects. Despite strong national and European research partnerships, the unit aims to further broaden its internationalisation through improvement activities such as joint projects and staff exchange.

The unit is also in line with the Latvian Open Science Strategy. It has a Scientific Activity Development Plan (2024-2030), which covers and develops open science and FAIR data principles, and Citizen Science is included in E³UDRES² activities.

Recommendations

- The number of active researchers contributing to publications should be increased through internal training and by integrating early-career researchers into the publishing process. Early-career researchers should be systematically integrated into ongoing projects as co-authors, supported through mentoring schemes and writing groups.
- To increase a better balance between the basic and applied sciences, in addition to the clear institutional goals, interdisciplinary projects that naturally blend fundamental science with practical applications should be encouraged, performance indicators could be created, and partnerships between universities, research institutes, and industry could be fostered.
- Enhancing the quality of research is essential to ensure that the findings meet the standards required for publication in high-impact international scientific journals. The unit should invest in strengthening methodological rigour, adopting state-of-the-art analytical tools, and aligning research questions with global scientific debates.
- A more ambitious approach to utilising research opportunities is needed, with stronger, broader European-level networks. This includes expanding collaboration beyond regional partners in various countries and actively applying for Horizon Europe funding across its different pillars. While the E³UDRES² alliance is a strong foundation, additional partnerships with leading European universities and research centres are needed to diversify expertise and increase competitiveness.
- In addition to the unit's investments in its own research infrastructure, its strategy is to use its partners' external research infrastructures. To succeed, many actions should be implemented - the unit should create strategic coordination, make shared investment,

facilitate joint training programmes, share supervision of doctoral students, and create a digital platform that lists available infrastructure, access procedures, and contact points. It would also be important to monitor the usage of shared infrastructures.

- To improve the quality and attractiveness of doctoral studies, the unit should expand co-supervision with experienced senior researchers from partner institutions, thereby ensuring higher academic standards and greater diversity of expertise. Structured supervisor training - covering mentoring practices, research ethics, and supervisory skills - would enhance the overall quality of guidance offered to students.
- To attract doctoral students, promote research strengths, highlight ongoing projects, use presence in conferences, and apply for Marie Skłodowska-Curie Actions to improve visibility and credibility and make the offered support and success stories known.

E_3 Latvia University of Life Sciences and Technologies - Engineering and Technology

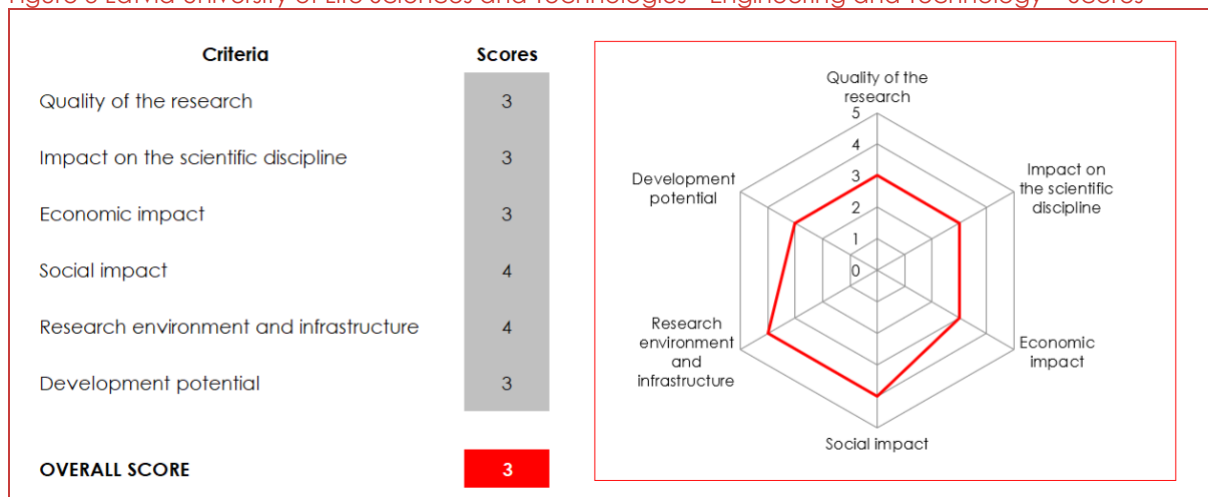
2.2.5 The unit

The Latvia University of Life Sciences and Technologies (LBTU) is one of four science universities in Latvia. Its vision is to become a modern, nationally and internationally recognised science university, being a leader in innovation in the bioeconomy and related industries, and in the sustainable use of natural resources across the Baltic Sea region. The goal of the unit is to study and transfer knowledge derived from engineering research into materials, products, technologies, and innovations aimed at promoting sustainable economic development and enhancing the quality of life for society and the environment. LBTU conducts research in three scientific specialisation directions: life sciences, engineering sciences, and social sciences. Research in the Engineering Sciences unit focuses on three key areas: smart materials and products, technologies for sustainable development, and innovative solutions for implementing circular economy principles.

2.2.6 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 3 Latvia University of Life Sciences and Technologies - Engineering and Technology – Scores



Overall score

Score 3: good level of research

The Expert Group awards the unit an overall score of '3', recognising it as a good national research performer with increasing international visibility. The unit has successfully implemented recommendations from the previous evaluation by consolidating its research directions into three well-focused and strategically aligned topics - smart materials and products, technologies for sustainable development, and innovative solutions for circular economy principles - which have improved coherence and overall research quality. Scientific output has grown substantially, with increased publication amount and scientific activity in reputable international journals indexed in Web of Science and Scopus. Nevertheless, an FWCI lower than one suggests potential for improvement to enhance its influence on the discipline. The unit has a notable success in securing competitive funding, particularly through EU structural funds. The unit demonstrates good impact on its scientific discipline, both nationally and internationally, through active participation in European and global research networks, editorial boards, and collaborative projects.

Economic and social impact is strong, reflected in productive industry cooperation, technology transfer, patent activity, spin-offs, and contributions to national policy and sectoral development, especially in food technology, bioeconomy, and sustainability transitions. A well-

developed research infrastructure and coordinated institutional support provide a solid foundation for future growth, although challenges remain in increasing high-impact publications, leading major international projects, and strengthening the academic staff structure. Overall, the unit shows strong development potential and is well positioned to further strengthen its role as a key research actor in Latvia and as an increasingly visible partner internationally.

Quality of Research

Score 3: good

Overall, the unit is a strong national player with some international recognition. As recommended in the previous evaluation carried out in 2019, the unit has made a significant effort to reduce the number of research directions from 14 to 3 well-focused research topics: smart materials and products, technologies for sustainable development, and innovative solutions for the implementation of circular economy principles. These three research topics align with the specialisation areas defined by the LBTU strategy and have contributed to improving the quality of research, thereby increasing the quality of scientific publications, and promoting their publication in Q1 and Q2 journals.

The total number of papers in peer-reviewed scientific edited journals and conference proceedings included in Web of Science or SCOPUS databases has increased significantly. Researchers of the unit have published the results of their research mainly in good journals included in the WoS and SCOPUS databases. 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 over 1000 papers, i.e., on average 170 per year. Nevertheless, the number, when normalised by the total number of academic research personnel (roughly one paper per academic research personnel per year), is still modest. The impact of the research is moderate, and no papers have been published in outstanding journals. The quality of full-text articles submitted for review is good but not outstanding.

The unit reported acquiring €15.5m in funding during the evaluation period, of which €6.6m was base funding and €8.8m was secured through European and national competitive research projects, particularly from EU structural funds, which form a significant part of the competitive funding. While base funding has increased gradually during the period 2019-2024, the competitive funds have slightly decreased compared to the amounts in 2019 and 2024. The ratio of competitive funding to base funding is modest, and an effort should be made to increase the acquisition of European competitive funds through participating in and leading projects in the framework of Horizon Europe and the ERC.

Impact on scientific discipline

Score 3: good

Overall, the unit has a strong impact at the national level within its field and is becoming a significant international player, with good international recognition. There is strong involvement of academic personnel in European and international networks and projects. This includes, for instance, projects on increased drainage effects on soil properties and water quality (IDESoWa) and new governance models to enhance nutrient pollution handling and nutrient recycling (NENUPHAR). The international profile of researchers is evidenced by memberships on editorial boards, including the Baltic Journal of Modern Computing and the Journal of Digital Landscape Architecture, and awards. The unit has made an effort to increase its visibility by increasing collaborations with institutions from many European countries and others, such as Argentina, Ghana, Indonesia, Ethiopia, Chile, and Mexico, through research projects in the framework of Horizon 2020, ERA-NET, EU LIFE, ERASMUS+, and international multidisciplinary collaborative research. However, the unit's collaborations in European projects are mainly as a partner, and the Field Weighted Citation Impact is lower than 1, indicating a lower-average citation impact compared to the global average papers' citation impact in the same subfield.

This suggests considerable potential for improving research impact and strengthening the unit's influence within the discipline.

Economic impact

Score 3: good

Overall, the research activity of the unit is significant, and a good level of interaction with non-academics is evident. The unit carries out knowledge and technology transfer, and the collaboration and interaction of the academic personnel with the private sector is substantial. In line with the recommendations of the previous evaluation, cooperation with relevant sectors, including agri-food, engineering and bioeconomy, of the national economy has been further extended and strengthened, thereby enhancing the impact of scientific research on industry and fostering the development of innovations with greater commercial potential, including new technologies and products. New technologies and products include the development of a new fruit sparkling drink and the development of gluten-free and gluten-rich pasta. However, private funding obtained (approximately €0.45m) decreased by 69% compared to the amount attracted during the period 2013-2018. Further efforts are recommended to strengthen partnerships with private companies to ensure a longer-term collaboration.

During the assessment period, the research results have been patented through registration of Latvian and European patents. By the end of 2024, the unit maintains eight patents, among them two European, and two licence agreements with companies operating in technology on a large-scale transport heating system, and concrete building elements. The unit has contributed successfully to the commercialisation of research results via the establishment of spin-off companies such as "Smart Indicators," "Skill Up," and an AI-based robotic weed control device "Weedbot."

While there are clear examples of commercialisation, the overall scale of economic impact remains limited relative to the size and breadth of the unit's research activity. Many outputs appear to be project-based or pilot-level, with limited evidence that they have yet been translated into sustained revenue streams, significant market penetration, or long-term economic transformation.

Social impact

Score 4: very good

Overall, the research of the unit is of significant societal relevance as evidenced by the involvement of its researchers in various Latvian non-academic councils, expert working groups in engineering sciences, and working groups of Latvian public authorities, e.g., Nutrition Council, Environment and Energy Advisory Council, the Expert Working Group on Climate Change Adaptation, the Drainage Advisory Council of Ministry of Agriculture and State Land Service Advisory Council showing that the Faculty's interaction with the public and policy makers is at a very good level.

The unit's research has made a significant contribution to economic, social, and educational development, effectively addressing the diverse needs and challenges of society. The knowledge developed through research has been integrated into 31 curricula in engineering and technology, strengthening the links between research and education.

In the area of quality and safety of life for society, the research conducted has contributed to a better management of natural resources (soil, water, air, landscapes) and human-made infrastructures and goods (water treatment systems, transport and construction). The research in the development of food products, packaging, and supplies for the national armed forces, as well as the creation of long-term solutions for food provision during crises, has a significant interest in the area of national security and defence. Food Institute scientists work closely with

health scientists to create solutions and propose new developments in food production for vulnerable groups of society.

The dissemination of the results organised by the unit to the society in regional and national media, blogs, and social media is at a very good level. This included interviews of researchers on national TV and radio, including LTV1, V33 and Riga TV24. The unit plays a crucial role in promoting initiatives, organising events and fostering innovation within Latvia's food industry. By hosting the EIT Food Hub in Latvia, LBTU fosters collaboration and development of the agri-food and bioeconomy sectors, and the unit plays an important role in enhancing Latvia's international visibility in the food industry.

Research environment and infrastructure

Score 4: very good

In terms of research infrastructure, the unit provides high-standard laboratory facilities, creating a very good research environment. The research infrastructure is highly competitive at the Baltic level. Research infrastructure management and development is coordinated by the Vice-Rector for Science, which allows for optimising the use of resources. In the period 2019-2024, the unit received €27.7m (shared with other LBTU entities) for infrastructure and institutional development projects. LBTU plans to invest at least €10m in infrastructure and development during the period 2025–2029. This is a modest sum, but realistic.

The institution has a range of facilities, including a computerised testing line and fuel consumption meter within the Institute of Engineering and Energetics, and an industrial computer kit and AR equipment available within the Institute of Computer Systems and Data Science. The institution demonstrates the ability to ensure open access to research results by modernising scientific data management processes and fundamental library sources.

Although tenured professors have been assigned to the engineering sciences, the academic personnel, in terms of full-time equivalent, and the senior researchers and researchers have decreased by around 30% over the period 2019-2024, but this did not seem to have affected LBTU's research output proportionately. The number of visiting researchers also decreased substantially during the period. The unit is making efforts and investing resources to improve the age structure of the research and academic staff by attracting younger personnel to create conditions for productive scientific work with significant research results. To attract younger staff, measures have been implemented, such as the offer of post-doc grants and offering exit grants to researchers older than 65 years who are willing to pass their knowledge and experience to younger colleagues.

Development potential

Score 3: good

The unit has a reasonably clear vision for the future and well-defined plans to advance and consolidate its emerging research directions in collaboration with national/international partners. These research directions are well aligned with the priorities of the international scientific community, particularly in the areas of advanced technologies, the development of new and innovative materials, renewable energy solutions, the production of biodegradable materials from agricultural and forest residues, and the application of artificial intelligence to food systems and natural resource management and will position LBTU as a significant player in addressing global challenges related to innovative solutions for the implementation of circular economy principles.

Strengths, weaknesses, opportunities, and threats are realistically assessed. The ability to attract high-level doctoral students and scientists from abroad is moderate, although numbers are increasing. This is considered a threat and reduces the pool of potential PhD students and talent retention. Difficulties in personnel retention due to lower academic salaries compared

to those offered by industry remain a significant threat, as they limit the establishment of stable, long-term research teams in certain engineering fields. To enhance the attractiveness of research careers, LBTU could collaborate with government bodies and industry partners to increase funding for research positions, offer more competitive salaries, and provide long-term contracts and clear opportunities for career progression. The introduction of two tenure-track positions specialised in engineering sciences will enable the unit to attract top-level researchers.

The newly planned Virtual and Augmented Reality Laboratory, the Interdisciplinary Remote Sensing Laboratory (scheduled to open in 2025), and the Agricultural Robotics Laboratory (scheduled for 2026) will strengthen the interdisciplinary research base supporting both international and national projects in the fields of agriculture and forestry.

To mitigate the negative impacts of potential threats, the unit will continue to diversify its funding sources by applying for and leading EU research programmes, international grants, and collaborative projects with foreign institutions, thereby reducing its dependency on national funding.

Overall, in the next 5-10 years, the unit will be able to strengthen its position in the international scientific community as a convincing actor and a trustworthy partner in international collaborative networks.

Potential to offer doctoral studies

The unit offers four unique doctoral programmes in Latvia - Agricultural Engineering, Food Science, Landscape Architecture, and Wood Materials and Technology - which belong to the field of engineering and technology and are of high importance for Latvia's academic environment, as well as for public and private sector stakeholders.

Therefore, LBTU doctoral curricula are of high importance for Latvia's academic environment and significant for public and private sector stakeholders. 31 doctoral/PhD theses were defended between 2019 and 2024 in engineering sciences. 59% of doctoral graduates continue their professional careers as lead researchers, or as researchers embarking on an academic career at LBTU. Thus, the unit provides satisfactory training for doctoral students, with a good number of theses defended in the evaluation period.

However, a significant percentage of doctoral graduates exceeds the normative time to degree due to the lack of scholarships and excessive bureaucracy in the administrative process. The average number of defended doctoral theses in the unit is five per year during the period 2019-2024. Thus, the number of doctoral graduates among the total academic research personnel is modest, partly due to the prevalence of part-time academic positions.

Alignment with the Smart Specialisation Strategy

The research and education activities at the unit are in line with the achievement of the relevant national policy goals regarding RIS3, industrial development and the quality of education in Latvia. The unit is focusing on RIS3 priority areas - knowledge-intensive bioeconomy, smart materials, technologies, and ICT, through interdisciplinary research.

The research activities and projects have had a positive impact on the implementation of RIS3 by promoting capital gains from: transfer and absorption of research results, knowledge and technologies in entrepreneurship; stimulating creation, production and sales of knowledge-intensive, high-added value, globally competitive products and services, and increasing the innovation capacity of Latvian enterprises, especially SMEs.

Conformity with state scientific and technology development

The strategy of the unit fully corresponds to and supports the implementation of Latvia's strategies and development plans, as well as EU strategies. The unit develops good quality research, with increasing international collaboration, and seeks to increase innovation capacity and the socioeconomic value of research by actively collaborating with the private sector, being the key focus of Latvia's Science, Technology Development, and Innovation Guidelines 2021-2027.

The scientific and higher education activities of the unit are closely aligned with the strategic objectives outlined in national strategic and policy documents such as the Education Development Guidelines 2021-2027 and National Industrial Policy Guidelines 2021-2027.

The unit is able to attract PhD students due to the established PhD study programmes. The unit invests in human capital and promotes the development of an innovative and eco-efficient economy through knowledge transfer, thereby fully aligning with the priorities of Latvia's Sustainable Development Strategy until 2030.

Recommendations

The Expert Group makes the following recommendations:

- Although the research of the unit is of good quality, the number of high-quality publications in internationally prestigious journals should be increased to improve the reputation and international visibility of the university. To achieve this, the unit should prioritise research questions aligned with global scientific debates, encourage team-based writing of high-impact manuscripts, and provide internal support for publication development, such as writing workshops, internal and external peer-review circles, and language editing services.
- The unit should aspire to lead international European projects in its core fields. Therefore, it should increase its visibility and intensify networking by actively participating in European research platforms, advisory boards, and major international conferences and attracting talent with strong international profiles who can act as principal investigators and project coordinators.
- The ratio of junior professors to senior professors (young assistant professors vs. associate and full professors) is generally not balanced and should be brought to an internationally comparable level. Moreover, the unit should organise and invite more long-term visiting researchers of well-established scientists from abroad and participate in their research areas. Increasing the number of long-term visiting researchers and internationally recognised scientists by actively applying for mobility schemes and fellowships (e.g., sabbatical hosting, Horizon Europe) will strengthen the academic environment, introduce new methodologies, and stimulate high-impact collaboration.
- The Expert Group recommends that the unit strengthen the scale and sustainability of its economic impact by developing longer-term, strategic partnerships with private companies and by addressing the recent decline in private-sector funding. Further efforts should focus on systematically supporting the growth, internationalisation, and commercial performance of patents, licences, and spin-off companies, in order to move from project-based commercialisation towards sustained and scalable economic outcomes.
- The unit should consider prioritising an increase in the number of international doctoral candidates by increasing involvement in joint doctorates with international universities and participating in doctoral networks, such as Marie Skłodowska-Curie Actions, to attract high-quality students.
- Despite efforts made by the unit during the evaluation period to slightly decrease the proportion of doctoral graduates exceeding the normative time to degree completion, further improvements should be made. In this context, several measures may be implemented to support this objective, including reducing administrative bureaucracy and

providing full-time scholarships for doctoral students, thereby facilitating more efficient progress toward degree completion.

- Following discussions with doctoral students, it was observed that many research outputs are derived from doctoral theses. It is recommended that the unit prioritise enhancing the quality of these outputs rather than focusing primarily on their quantity.

E_4 Institute of Mathematics and Computer Science - University of Latvia

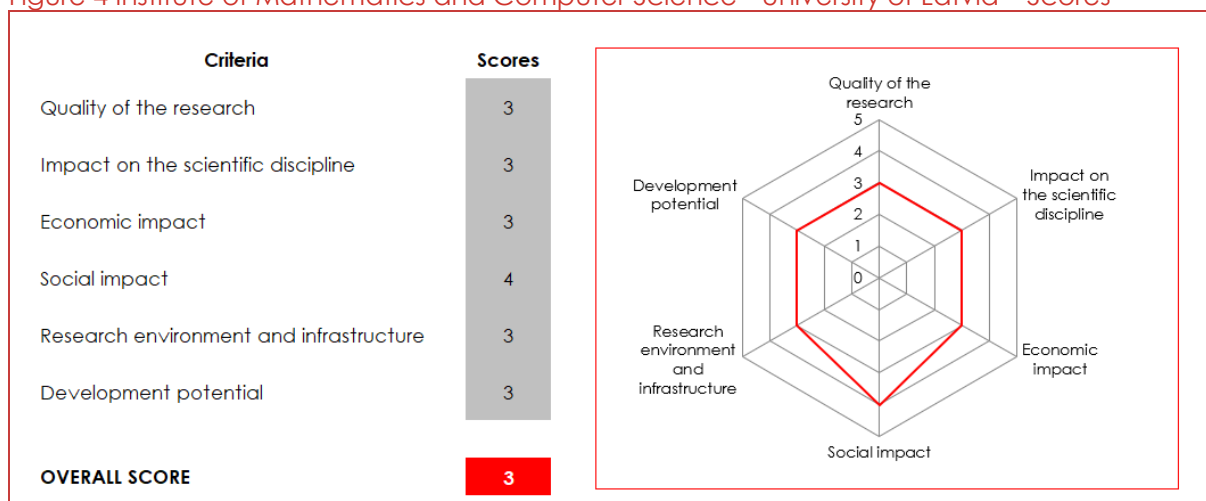
2.2.7 The unit

The Institute of Mathematics and Computer Science, University of Latvia (IMCS UL) is a research institute focusing on engineering and technology, with a strong interdisciplinary approach integrating natural sciences. The unit's mission is to conduct high-profile fundamental and applied research in mathematics and computer science, fostering innovation, industry cooperation, and education for societal benefit. The unit is designated as the National Institution for Information Technology Security Incident Prevention and provides top-level domain name registration services in Latvia. IMCS UL organises its research around the four research directions: Artificial Intelligence, applied technologies and algorithms, mathematical methods and technologies, and innovative application-oriented services. Key research areas include language technology and computational linguistics, deep learning, knowledge engineering and knowledge graphs, quantum communication technologies, cybersecurity, bioinformatics and biomedical informatics, real-time and autonomous systems, mathematical modelling and dynamical systems, many-valued mathematical structures, and national-level cyber incident response and top-level domain name administration.

2.2.8 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 4 Institute of Mathematics and Computer Science - University of Latvia – Scores



Overall score

Score 3: good level of research

The Expert Group awards the IMCS UL an overall score of '3', recognising the unit as a strong national research performer with several areas of clear international visibility. The unit demonstrates particularly impactful contributions in Latvian language technologies, bioinformatics, and biomedical informatics, where research outputs and infrastructure have substantial national and societal importance. The publication profile shows a mixture of high-quality outputs and publications in more modest venues, and only a limited number of highly cited works. A mere 4.2% the unit's publications are included in the 10% most cited venues in their subfield, according to the HCP10 bibliometric indicator. Interaction with non-academic stakeholders, especially institutional partners, is well established and results in meaningful social impact, supported by the unit's unique role in maintaining national language resources and contributing to cybersecurity and digital infrastructure. The research environment is generally adequate, and the unit shows good development potential, underpinned by strong research groups and emerging areas such as quantum communication technologies. Overall, the unit

performs at a good level, with a solid foundation on which to build increased international competitiveness.

Quality of Research

Score 3: good

The Expert Group scores the quality of research as '3', recognising the unit as a strong national player with some international recognition. Particular areas of strength are bioinformatics, language technology, and computational linguistics, but significant work is also conducted in, for instance, AI, quantum communication technologies, and real-time systems. Quantum communications technologies is a recently launched new major strategic research direction for the unit, still under development. This subject is very timely and an area of research with many open questions that holds potential for research of international interest.

The quality of the publication venues used by the unit is mixed. Also, the number of authored publications varies. The unit's strongest research directions are published in highly regarded international journals such as Nature, Computational Linguistics, and Language Resources and Evaluations. However, in other fields, venues of more modest reputations are used, including the controversial MDPI journals.

The unit has secured 12 grants from the Latvian Science Council, mostly for work in the unit's strongest research areas. Moreover, the unit reports participation in three Horizon 2020 projects, an improvement from the single Horizon 2020 project reported in the previous period.

The self-assessment report highlights a weakness in terms of the limited strength of leadership and low performance in mathematics research. The areas of mathematics research listed in the self-assessment report are indeed quite classical, with some of the listed areas presently attracting limited attention in the international mathematics community. Nevertheless, compared with other research areas, the total number of publications in mathematics, as specified in the self-assessment report, is reasonably high. However, the publication venues for the mathematics research, although mostly in Q1/Q2, are not in the international top journals. For instance, the two mathematics articles provided in the list of most important publications appeared in the MDPI journal Axioms, a publisher with a questionable reputation. This reported weakness is indeed a serious issue for an institute of mathematics and computer science. The Expert Group appreciates the openness and honesty in reporting this problem. When questioned by the Expert Group during the site visit about the reported weakness, not much additional information was gathered, other than problems with attracting students to mathematics research.

Impact on scientific discipline

Score 3: good

The Expert Group scores the impact on the scientific discipline at '3', recognising the unit as a strong national player with some international recognition. The activities around Latvian language resources, such as the lexical database, the Corpora Collection, the language models, and the speech recognition and synthesis systems, are of central importance to Latvia and the international community. The unit has a substantial national impact through a variety of institutional collaborators, such as industry associations, government advisory boards, national archives, and national defence.

The international impact of the research in bioinformatics and biomedical informatics is substantial. In the other research areas presented in the self-assessment report, the impact is more limited. The bibliometric analysis shows that the average number of citations is at a good level, but only 4.2% of them appear in the highest-cited journals. An increased international presence and impact of the unit can be expected from the increased participation, compared to the previous reporting period, in Horizon 2020 projects. However, the unit has not

yet coordinated a Horizon 2020 project. Additional international impact emanates from participation in various committee work and other international cooperation initiatives.

Economic impact

Score 3: good

The Expert Group scores the economic impact '3', recognising the unit as providing important research and a satisfactory level of interaction with non-academics. As could be concluded from discussions with collaboration partners during the site visit, the unit demonstrates collaboration with non-academic partners, such as for instance the Ministry of Defence department and the National Archives. Due to the nature of the dominating activities of the unit, both in research and the large amount of service undertakings, having many institutional collaborations is natural and obviously very important. While the unit has been able to acquire a total amount of €6.9m in the evaluated period from various sorts of financing, the Expert Group notes that many of the industrial collaborations are in the form of partners in Horizon 2020 projects. The Expert Group believes that a larger involvement of industrial partners would be natural and beneficial.

A special case is the activities contracted from the Telos Alliance, which involve company-specific research and development. This includes, besides the cooperation with industry and expert communities worldwide, also the organisation of standards. For example, the standard AES67, initiated by IMCS UL and Telos Alliance, has become the basis for globally implemented standards of the Society of Motion Picture and Television Engineers. Also, there is a substantial economic impact from the services provided by the CERT.LV laboratory and NIC.LV registry operator.

Social impact

Score 4: very good

The Expert Group scores the social impact of the unit '4', very good. An obvious motivation for the high score is the unique social and cultural role the unit plays for the Latvian language in terms of its management of Latvian language resources, for instance, the lexical database, the Latvian corpus, and the speech recognition and synthesis software. The large user base of the resources and tools, for instance, 300k unique visitors to the lexical database each month, underscores the social and cultural impact of the work. Moreover, the language resource team has participated in citizen science initiatives and has begun collaborating with Meta/Facebook through its Partner Programme. The activities in quantum communication infrastructure, cybersecurity, and bioinformatics also address important societal questions, and the unit has demonstrated significant impact in these areas during the reporting period. Several groups are also active on social media, disseminating research findings. The platforms used by IMCS UL to disseminate research findings include their own website and Facebook. Similarly, the AI Lab has used an X (formerly Twitter) account with 800 followers since 2010 and a Facebook account since 2024 with 200 followers, where they regularly post news on events and initiatives.

There is also a substantial social impact from CERT.LV and NIC.LV, for instance, from the former by providing support to several universities on cybersecurity education and providing core technological expertise to cybersecurity policy, strategy, and implementation. The importance of CERT.LV's work for society has been emphasised in evaluations of national bodies, including the National Security Council, the National Cybersecurity Council, and several committees of the Latvian Parliament.

Research environment and infrastructure

Score 3: good

The Expert Group scores the research environment and infrastructure of the unit '3', a strong national player. Regarding the long-term strategy for developing research personnel, the self-

assessment report notes that personnel are typically recruited from the pool of bachelor's or master's students participating in research projects. This was also confirmed during the on-site meeting with the students. The unit thus concludes that the crucial factor in recruitment is the ability to attract research funding, for instance, by supporting, in particular, young researchers in project applications. The ability to provide competitive salaries has improved during the evaluation period, and the median age has stabilised at around 47 during the evaluation period. Another important issue, mentioned in the self-assessment report (Strategy for the Development of Scientific Personnel), is to prioritise researcher training through international mobility and industry connections. These efforts are commendable, but more concrete plans for these activities were not provided, neither in the self-assessment report nor during the interviews.

The unit hosts extensive physical infrastructure. Indeed, half of the funding for the unit comes from infrastructure and development projects. This large number can be explained by the large amounts of services conducted by the unit, but the breakdown of the funding between service and research infrastructure is not clear from the self-assessment report. Moreover, state funding for infrastructure has increased substantially over the last two years, by about 65% and 40%, respectively.

The central infrastructure comprises network services and a data centre. Noteworthy is that the data centre houses a powerful GPU system for ML training, a facility that is presently of great importance for a unit like this. Outside of network services and the data centre, the infrastructure is built and maintained by the various research groups. Highlights here are the recently acquired state-of-the-art equipment for quantum communication research and up-to-date tools for the Real-Time and Autonomous Systems research. At the international level, the unit is a partner in the Common Language Resources and Technology Infrastructure, a European Research Infrastructure Consortium.

Development potential

Score 3: good

The Expert Group scores the unit's development potential as '3', good. In general, the subject of mathematics and information technology is clearly relevant to current affairs. The unit is well-positioned internationally in certain areas, such as language technology and bioinformatics, whereas other areas are still developing. A particularly promising, recently launched innovative research direction is quantum communications. These research areas can be expected to continue to thrive and to develop further.

The structure of the unit seems unwieldy, with fundamental and applied research, contract industrial R&D, and service providers all mixed together within the same organisation. The benefits of such an amalgam are not clear to the Expert Group. The strategy plans in the self-assessment report are short, rudimentary, and modest, outlining a continuation of the unit's current activities and policies without any significant changes. For instance, problems in the mathematics area are discussed in a remarkably candid and honest way. Nevertheless, the proposal is to continue as before, without rethinking whether a change of direction would be beneficial. All of the above leads, therefore, to the unavoidable impression that strategic leadership is mostly delegated to the research groups, suggesting an imbalance between top-down and bottom-up decisions.

Potential to offer doctoral studies

Much of the research conducted at the unit is well-suited to doctoral research. However, the unit does not offer doctoral studies itself; instead, it partners with university departments in three ways. First, the unit has participated in a European Social Fund project "Strengthening UL doctoral capacity under the new doctoral model," led by the University of Latvia. Five doctoral

students have received funding through this project and conducted their research at the unit. All of them are expected to graduate by 2025. Second, some employees of the unit without doctoral degrees are enrolled in doctoral programmes, not necessarily only at UL. During the evaluation period, six doctoral projects of this kind have been conducted and defended. But it is not clear how many employees of the department are enrolled in doctoral studies. Third, 18 doctoral students (with unclear affiliation) have been involved in various research projects at the unit.

In summary, the unit does not seem to prioritise doctoral studies among other tasks. A fairly large number of doctoral students are welcome as co-workers in projects. However, the number of dissertations defended during the reporting period is low; six doctoral theses were defended between 2019 and 2024. The possibility of conducting doctoral studies in the specified nominal time depends on the availability of dedicated funding. The pool of doctoral students at the unit, dedicated mainly to doctoral studies, appears therefore to be subcritical to maintain a suitable environment at the unit itself.

Alignment with the Smart Specialisation Strategy

The unit aligns well with priority area two, biomedicine, medical technologies and biopharmacy through the research conducted by the research group in bioinformatics and biomedical information. Moreover, all research groups in the unit fall, by the nature of their research, squarely into priority area five: information and communication technologies.

Conformity with state scientific and technology development

The unit conforms well with several central objectives of the Science, Technology Development, and Innovation guidelines. In particular, the objectives 'to strengthen national science and innovation capacity to transition Latvia toward a knowledge-based economy,' and 'foster collaboration between academia, industry, and public sector' are very well covered by the unit. A knowledge-based economy is built on information technology, which is the core mission of the unit's research. The strengthening of national science is particularly noticeable in the language technology research devoted to the Latvian language. The important collaborations with institutional partners particularly well cover the latter objective, although the collaboration with industry could be further developed.

Recommendations

- Strengthening bilateral partnerships with industrial stakeholders, especially in fast-growing ICT and biotechnology sectors, could significantly enhance the unit's applied research profile and economic impact. The unit could introduce mechanisms for industry-initiated problem statements, co-funded PhD positions, joint labs, or industrial postdoctoral placements. A systematic approach to industry engagement would help shift the current reliance on institutional partners and stimulate innovation activities with tangible impact. A continued increase in such projects would be a natural aim for the next period.
- Regarding mathematics at the unit level, the Expert Group proposes a consolidated effort for renewal rather than simply extrapolating current directions. One option could be for management to form an independent group of experts to analyse, investigate, and propose a future framework for recruitment and development. For the success of such an effort, it is necessary to make some funds available for a few strategic recruitments.
- There appears to be an imbalance between bottom-up and top-down decision-making, where the bottom-up dominates too much. An action could be to ensure that unit-strategic issues and plans are continuously developed, for instance, by a committee composed of participants from all research groups. Another option could be to form an exterior advisory body to the management.
- The combination of fundamental research, applied R&D, contract research for industry, and national service providers (CERT.LV and NIC.LV) within a single unit creates structural

complexity and blurs boundaries between research and service functions. The Expert Group recommends analysing alternative organisational models that clearly differentiate research activities from operational service functions. A more streamlined structure would allow research groups to focus on scientific excellence, reduce administrative burden, and improve eligibility and competitiveness for international research funding.

E_5 Institute of Electronics and Computer Science

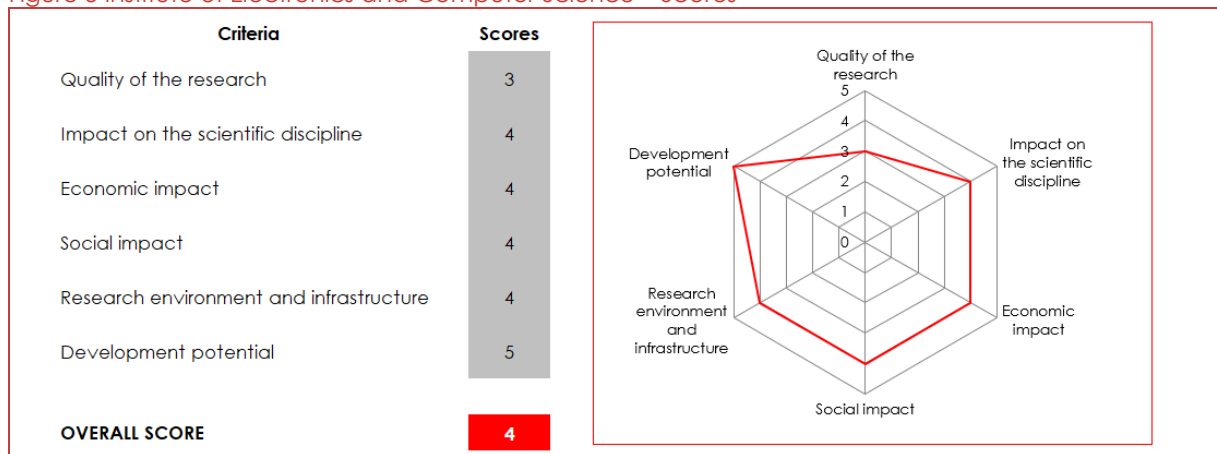
2.2.9 The unit

The Institute of Electronics and Computer Science (EDI) is a research institute focusing on engineering and technology, particularly in the fields of electronics and computer science. EDI's mission is to perceive the world and design a better future by generating new knowledge, developing innovative technologies and demonstrating their practical significance through real-world applications. EDI's goal is to be a leading global institution in the research domains of extremely precise event timing (incl. space domain), remote sensing and space data processing, robotics and machine perception, AI, signal processing and embedded intelligence, and smart sensors and IoT. The unit emphasises interdisciplinary and multidisciplinary research. EDI collaborates with international partners and industry, focusing on practical applications and the commercialisation of research outcomes.

2.2.10 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 5 Institute of Electronics and Computer Science – Scores



Overall score

Score 4: very good level of research

The Expert Group awards the Institute of Electronics and Computer Science an overall score of '4', indicating a very good level of research. The unit conducts applied research of high quality, comparable to highly regarded international industrial research institutes. The unit's impact on the scientific discipline is very high, as documented, for instance, by its participation in many Horizon Europe projects and excellent citation statistics. The economic impact of the unit is also very good, resulting in the successful commercialisation of key technologies and cooperation with industrial partners who unanimously praise the competence of the unit. Moreover, substantial parts of the research concern sustainable innovation in socially highly relevant areas. The unit is very well managed; its budget has grown tenfold during the evaluation period; it has a well-thought-out strategy to foster young researchers; and it hosts a fully modern research environment that has seen further investments in recent years. Based on this history, the Expert Group views the development potential of the unit as excellent.

Quality of Research

Score 3: good

The Expert Group scores the quality of research at '3,' good. The unit conducts good-quality, mostly applied research. The type of research that is conducted can be compared, as is also done in the self-assessment report, to the research coming out of industrial research institutes such as the German Fraunhofer Institute and VTT technical research centre in Finland. The focus of the unit is naturally, therefore, more on practical industrial impact rather than groundbreaking original fundamental research. This aim is mirrored in the subjects covered in the most important publications specified in the self-assessment report. Unfortunately, none of the publications appears in the top journals in the respective fields. More troubling is that many of the publications appear in the controversial MDPI journals (e.g. Electronics, Applied Sciences). This publication pattern does not, in itself, disqualify the quality of the individual publications, but it is worrying, since these journals generally have a reputation for a too-quick and inconsistent review process, which in other cases has led to the appearance of many low-quality publications.

Impact on scientific discipline

Score 4: very good

The Expert Group scores the impact on the scientific discipline of the unit at '4,' very good, that is, as a strong international player. The extremely precise event-timing technology is used by over 60% of International Laser Ranging Services worldwide, including NASA. Another example is an image-processing algorithm ("Dynland technology") that was delivered to the European Space Agency for exploitation in earth observation projects. Additional impactful work is the development of electronic equipment for quantum sensors. Noteworthy is also the participation of an employee of the unit as a programme committee member of the RISC-V Summit Europe, the most significant conference in Europe focused on open hardware.

The unit has participated in 31 Horizon and 11 other international research projects, and it has been coordinating one project, the Horizon Europe GoIT project, devoted to open-source hardware development. The unit reports a substantial participation in Horizon projects. It received €7.39m in EU Horizon 2020 and Horizon European Research and Innovation (RIA) projects, and €3.60m in Horizon 2020 and Horizon Europe Innovation Action (IA) projects. Such a strong project presence naturally leads to significant international recognition and impact. The unit organised in 2023 the International Workshop on Embedded Digital Intelligence, with 100 participants from seven countries.

The high interest in the research outcome is also clear from the citation statistics, which are high in both the average number of citations and the number of articles published in the highest-cited journals.

Economic impact

Score 4: very good

The Expert Group scores the economic impact of the unit at '4,' very good. The industrial and economic relevance of the research is very high. This conclusion is supported by the fact that the unit has been remarkably successful in increasing its budget during the evaluation period by one order of magnitude, both in base funding and competitive research projects. During the period, the unit recruited 129 new employees, with 58 successfully transitioning to industry, and registered 12 Latvian and 14 European patents.

Regarding cooperation with enterprises, the largest volume is through joint partners in Horizon projects, including Eindhoven University of Technology; more than 100 companies have served in that role. However, there have also been over a dozen direct research contracts with the unit, conducted with 21 companies, and there have been eight commercialisation/knowledge transfers, and three new start-ups. These numbers constitute a marked improvement from the previous evaluation period. One specific example is the commercialisation of the timer technology by the spin-off company Eventech.

The industrial collaboration partners stressed during the site visit interviews the unit's unique understanding of industrial needs, such as quick engineering results, know-how on 'how to go to market,' and its willingness to adapt to industry needs. All this solidifies the general impression of the unit as a very successful industrial research institute.

Social impact

Score 4: very good

The Expert Group scores the social impact of the unit at '4', very good. A substantial portion of the research concerns sustainable innovation in socially relevant areas such as health, environment, mobility, industrial production, national security, and space technology.

The unit has an unusually structured approach to the reporting of science communication and outreach activities. The number of activities is given in a matrix that specifies the activity type in the rows and the key target group in the columns. The unit identifies the following five key target groups: industry, academia/NGO, students/researchers, government/policy makers/funding bodies, and the general public. The matrix indicates many activities and a good spread of target groups, and the type of activity. As such, the SAR indicates a large online presence through web posts and social media (LinkedIn, Facebook, and YouTube), but also large numbers of TV and radio interviews (about 30 of each) and many public seminars and events (245). Moreover, hackathons, incubators, and accelerators have been organised.

The self-assessment report specifies that personnel from the unit have contributed to more than 30 science policy documents. One specific example is the development of the Electronic Components and Systems Strategic Research and Innovation Agenda (ECS-SRIA71), a key policy document that guides Horizon Europe Chips Joint Undertaking (Chips JU) calls, with an annual budget of approximately €300m. The unit has also contributed to Horizon Europe work programmes and several government policy documents, such as innovation policy documents for the Ministry of Economics, the Latvian Academy of Sciences, and the Latvian Council of Science.

Research environment and infrastructure

Score 4: very good

The Expert Group scores the research environment and infrastructure of the unit at '4', very good. The unit is very well managed, as is clear from the presentation in the self-assessment report as well as from the impression given to the Expert Group during the site visit.

One strategy that appears to have been particularly successful is the concerted effort to let students and young researchers take significant responsibility early in their careers, and to dedicate funds to send students and young researchers abroad for visits. Based on recommendations from the Expert Group of the previous evaluation, the unit developed a Gender Equality Plan and established a dedicated committee. These efforts seem to have had an effect. The female share of the employees has risen from 12% to 19%, which is high in engineering and computer science. The staff's age distribution is balanced.

The unit possesses state-of-the-art facilities and physical infrastructure at an internationally comparable level. The unit maintains an open access policy to the infrastructure for all

academic and industrial partners with a well-thought-out and organised administration. The greatest interest is in prototyping, testing and high-performance laboratory equipment, the smart electric vehicle, and High-Performance Computing (HPC) resources.

To maintain an already good level of research infrastructure, the unit has invested about €2 million in infrastructure upgrades since 2019. These involve building renovations and the creation of a test bed for smart car prototyping and intelligent transport systems. Moreover, a large amount of state-of-the-art laboratory equipment has been upgraded.

The unit plans to invest an additional €2m in infrastructure during the next three years. These funds will cover the adaptation of premises for the integration of the Institute of Physical Energetics into EDI, new HPC resources, robot systems, etc.

Development potential

Score 5: outstanding

The Expert Group scores the development potential of the unit at '5', outstanding. This score is based on the impressive growth during the evaluation period, the clear vision and leadership of the management, the unit's participation in competitive international projects, and the impressive ability to foster young talent and provide responsibility and support already early in their career.

The Expert Group recognises that achieving global leadership as a research-performing organisation comparable to the world's leading universities represents a highly demanding ambition and would require further evolution of the unit's research profile, funding structure, and publication strategy. At the same time, the unit demonstrates particularly strong potential to position itself internationally as a leading research-innovation intermediary and applied research institute, combining high-quality applied and translational research with close engagement with industry. Strengthening access to funding streams that support more academically oriented research would further enhance the unit's ability to contribute at the highest scientific level in selected areas.

Realising this outstanding development potential will also depend on the unit's capacity to recruit and retain top-level international talent. Ensuring competitive employment conditions and remuneration aligned with international standards will be essential to sustaining excellence and enabling the unit to fully capitalise on its strengths and strategic direction.

Potential to offer doctoral studies

The unit does not offer doctoral studies, but partners with the doctoral programmes at the University of Latvia and Riga Technical University. A quite large number of doctoral students are reported as personnel carrying out research, and the unit seems to be an attractive institution for students interested in carrying out doctoral work: the unit offers interesting work in international projects, offers access to state-of-the-art research infrastructure, and the students have the possibility of initiating the purchase of new equipment. Also, according to the self-assessment report, the unit offers structured progress reviews through internal research seminars, a PhD "Lounge Club," and a scientific article writing group.

Nevertheless, the reporting of doctoral students in the self-assessment report is confusing. A large number of the personnel are reported as doctoral students. However, the number of students enrolled in doctoral studies and under the guidance of the unit's researchers is significantly lower. Moreover, very few doctoral dissertations have been defended during the reporting period. At least a partial explanation of these statistics could be what was communicated from the doctoral students during the site visit: the unit encourages personnel to enrol as doctoral students, but the motivation to actually finish may not be there. The burden

on the doctoral students to work on projects and, by the policy of the unit, to be active in acquiring and managing the projects, will result in too little time for academically suitable doctoral work.

This very slow throughput is a serious obstacle to the potential to offer doctoral studies at a high scientific level, and the unit needs to discuss solutions that allow more time to be set aside for the doctoral students to conduct actual doctoral work. In an institute like this that carries out so much international project work, it is reasonable that a longer time than the nominal is required for employed personnel who want to pursue doctoral studies.

Alignment with the Smart Specialisation Strategy

The unit is very well aligned and an active member of three RIS3 steering groups. The unit is a member of photonics, smart materials, engineering systems (PSE), smart energy and mobility (SEM), and information and communication technologies (ICT). Particularly important are the contributions to innovation by company collaborations and the creation of spin-off companies.

Conformity with state scientific and technology development

The unit conforms to a very high degree with the objectives of Latvia's policy goals in scientific and technological development. The central policy objective is to "drive industrial transformation with innovation as a central pillar" and "Increase national productivity, exports, and global competitiveness." The unit's extensive involvement in Horizon projects, the large volume of industrial contract research, and the extremely positive feedback from industrial partners during the site visit all demonstrate strong alignment with these objectives.

The Open Science Strategy in the policy guidelines is reflected in the publication strategy of the unit, which consistently uses gold or green open access. Moreover, all data and findings from Horizon projects are immediately shared with partners, and key data and findings are made public, according to the data management plan and dissemination activities.

A unique development in open science has been the unit's participation in the development of a possible GPL-compatible hardware license.

Recommendations

- **Clarify and strategically balance the unit's dual role as both a research performer and research-innovation mediator.**

The unit operates at the intersection of applied research, technology development, and industrial innovation. While this dual role has clearly contributed to its success, the strategic emphasis on conducting high-level research and serving as a bridge to industry warrants further deliberation. This may include distinguishing core research activities from activities focused primarily on technology transfer, prototyping, and industrial services, ensuring both missions receive sufficient resources and visibility.

- **Strengthen the capacity for long-term, high-level academic research by diversifying funding sources.**

If the unit intends to enhance its contribution to high-level scientific research, it will need to secure more funding appropriate for fundamental or investigator-driven research. This includes actively pursuing national research grants (e.g., Latvian Council of Science), EU postdoctoral or ERC schemes, and collaborative basic research calls.

- **Raise the quality and prestige of publication venues.**

Although the unit's applied orientation and industrial collaborations generate valuable outputs, the publication record remains limited in top-tier journals and conferences. The Expert Group recommends a more targeted publication strategy that prioritises venues with rigorous peer review and high scholarly impact and

encourages submissions to top conferences and journals in electronics, embedded systems, computer science, and related fields.

- **Enhance strategic human resource management to attract and retain top talent.**
The unit's impressive growth increases the need for competitive recruitment and retention strategies. To preserve and strengthen its talent base, the unit should consider developing competitive compensation packages aligned with international standards and establishing clear career progression pathways for senior and junior researchers.
- **Maintain and further develop state-of-the-art infrastructure with long-term sustainability plans.**
The unit has demonstrated a strong commitment to maintaining modern infrastructure. As the scale and cost of facilities grow, it will be increasingly important to establish multi-year investment plans and ensure sustainable funding for maintenance and upgrades.

E_6 CRYOGENIC AND VACUUM SYSTEMS Ltd

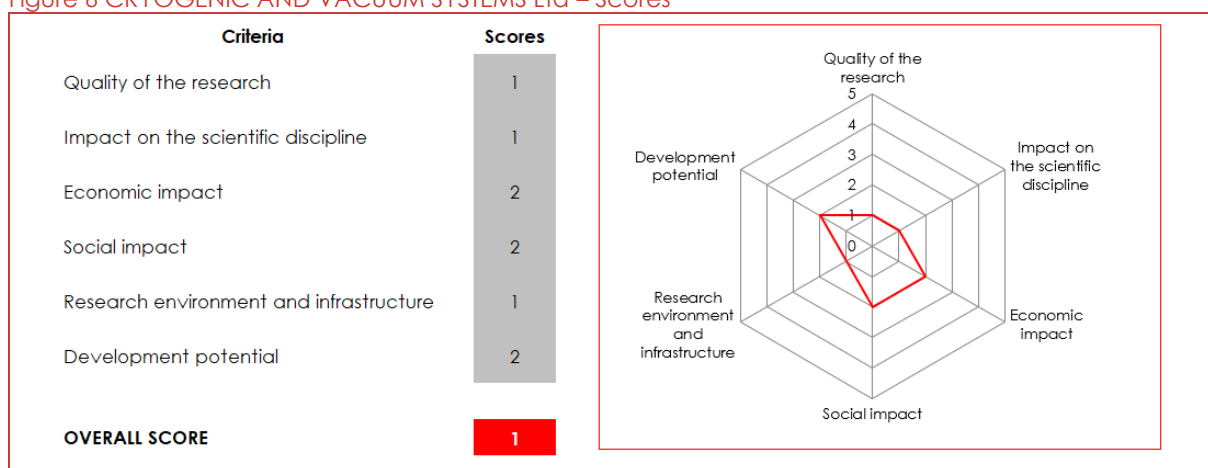
2.2.11 The unit

Cryogenic and Vacuum Systems Ltd (CVS) is a privately financed small and medium-sized enterprise (SME) based in Ventspils. Established in 2014, CVS focuses on multidisciplinary research with an emphasis on technological prototyping and commercialisation. The main research areas include aerospace engineering, electrical and mechanical engineering, vacuum and cryogenic systems, industrial biotechnology, and applied engineering technologies. The mission of CVS is to advance the technology readiness level of innovative products from concept to commercialisation; prioritising fields where deep engineering and interdisciplinary integration can lead to patents and marketable solutions. The company engages in partnerships with academic institutions and industry stakeholders, both nationally and internationally, to enhance its research outcomes and technological innovations.

2.2.12 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 6 CRYOGENIC AND VACUUM SYSTEMS Ltd – Scores



Overall score

Score 1: poor level of research

Cryogenic and Vacuum Systems (CVS) is a small unit with a focus on applied research and technology development. While the unit demonstrates industrial relevance through prototyping, patenting, and collaboration with companies, its scientific output remains limited. The publication record is modest, with contributions to low-impact journals, and the overall visibility and influence within the international research community are low. The research infrastructure is basic and sufficient for targeted applied work, but lacks the scale and sophistication required to support more advanced or competitive research activities. CVS does not have the possibility to offer its own doctoral education and has only limited engagement in joint doctoral initiatives. Its ability to contribute to academic training and high-level research collaboration is constrained by the absence of academic infrastructure and a small research staff. Although CVS aligns with national priorities such as RIS3 and contributes to economic and societal sectors through its technological outputs, these contributions are confined to niche domains. The breadth of research topics pursued is not well matched to the unit's size and resources, and a more focused strategy would be necessary to improve quality and impact.

Given the limited scientific output, low international visibility, basic infrastructure, and constrained academic engagement, the overall grade of '1' reflects the current position of CVS as a unit with industrial relevance but minimal scientific impact in an international context.

Quality of Research

Score 1: poor

CVS is a privately financed SME with 15 staff members, including six PhDs and one habilitated DSc. The unit focuses on applied research and technology development across a broad range of fields, including aerospace, vacuum and cryogenics, food processing, and industrial biotechnology. CVS operates primarily within TRL levels 4-9. While its applied research holds relevance in niche sectors such as food, pharmaceuticals, and space technologies, the scientific output remains modest, with a total of 15 (seven articles and eight conference proceedings) full-text publications in peer-reviewed journals and conference proceedings, primarily in aerospace engineering, materials science, and applied biotechnology fields. The number of publications is low in both absolute and relative terms, and those that exist are generally published in journals with limited scientific impact and low quality. None of the journals are listed in the HPC10 journals and the share of publications in Q1 journals is only 6,7%. CVS staff contribute to the innovation ecosystem through conference participation and expert roles, but the unit lacks academic infrastructure, such as advanced laboratories, large-scale computational resources, direct access to master's students and the possibility of offering doctoral training. One doctoral thesis has been based on CVS research, though broader academic engagement is constrained by limited international visibility and resources. Overall, CVS's activities are dominated by production and product development rather than research. Its strength lies in TRL progression and commercialisation, positioning it as a niche player in applied innovation rather than a contributor to high-impact scientific research.

Impact on scientific discipline

Score 1: poor

CVS has an orientation toward applied research and product development, which has led to industrial relevance but has limited its scientific contribution and international recognition. Relative to its size, the unit's publication record is modest, with most publications appearing in local conferences or lower-tier journals, and its citation impact is low, having had only 24 citations (including many self-citations) between 2019 and 2023. This indicates that CVS's research has had limited influence on the global scientific community. Although there are three reported patents, the overall scientific influence of the unit's research is limited. CVS has made progress in advancing TRL levels and delivering innovations in aerospace, vacuum and cryogenics, and biotechnology. During the evaluation period, the unit participated in 11 national and EU-funded projects, including Horizon 2020, ERDF, ESA, and the Recovery Fund initiative. Total funding exceeded €1.1m, and projects covered fields including cryogenic insulation systems and space testing platforms. Its TRL 6–9 R&D activities contribute to competitiveness and innovation in sectors such as food, pharmaceuticals, materials, and space. CVS has engaged in academic partnerships with institutions such as the University of Latvia and Kielce University of Technology in Poland. However, its international academic collaborations remain limited, and there is clear potential to strengthen the unit's scientific impact. Overall, the unit prioritises applied engineering and commercialisation, with only a marginal impact on scientific research.

Economic impact

Score 2: adequate

CVS operates as a high-technology SME with a business model that integrates scientific activity, including elements of fundamental research, engineering prototyping, and commercialisation. While this approach has rendered several advanced products such as industrial sublimators, microwave-assisted vacuum dryers, cryogenic deposition systems, and space testing equipment, the focus remains directed toward applied development. These innovations, reaching TRL levels 6-9, primarily serve industrial modernisation and export potential, but contribute less to advancing scientific knowledge. The unit's ability to deliver TRL 6–9 prototypes

positions it as a national player in Latvia's innovation ecosystem, bridging the gap between applied research and industrial application. Although CVS has grown from 5 to 15 employees and achieved a peak turnover of €422k in 2024, this remains small compared to larger research entities or high-tech firms. The company reports annual revenues of just over €100k from research projects and self-financed R&D, which, while notable for an SME, reflects a modest scale of scientific activity. However, the scientific output from these projects, measured in terms of peer-reviewed publications and international visibility, is limited. Its collaboration network spans over 70 companies across Latvia and the EU, resulting in the delivery of various technical systems. While these developments support competitiveness in sectors such as food, pharmaceuticals, materials, and space, they are largely commercial in nature, focused on product development rather than research, and do not significantly elevate the unit's academic profile.

Social impact

Score 2: adequate

CVS plays a role in Latvia's national innovation ecosystem, contributing through patents and advanced technologies. Its research projects span a broad thematic range, including microwave-assisted sublimation (SubliMik), cryogenic insulation systems, and space testing platforms. The sublimation technologies developed by CVS have potential societal relevance, particularly in promoting public health, environmental sustainability, and food security. However, these benefits remain confined to niche industrial applications. CVS also engages early-career researchers in practical scientific work, helping to bridge the gap between academic training and industrial application. However, the number of involved students is very low. The self-assessment report lists one completed Master's degree, one defended doctoral dissertation and one co-supervision for the defended doctoral dissertation. The unit's patented space environment testing technologies have received recognition at international conferences, contributing to Latvia's visibility in global space and engineering research. In summary, CVS's social impact is small because its efforts primarily support industrial innovation and commercialisation, while direct contributions to education, public understanding, and societal well-being are limited.

Research environment and infrastructure

Score 1: poor

CVS maintains a modest but functional research infrastructure that supports its applied engineering activities. The unit has access to electronic scientific journals and relevant literature, ensuring a basic foundation for research engagement. A laboratory equipped with simple measurement technology and basic tools is available, along with dedicated spaces for assembling and testing experimental setups. The laboratory is basic and shows no signs of advanced capability. It is suitable for simple, targeted applied research, but cannot be considered a comprehensive research facility comparable to those found at universities or companies engaged in advanced scientific work. Computational resources are present, though not at a high-performance level, and are sufficient for standard data processing tasks. While the infrastructure does not include advanced computing capabilities, the proximity to in-house production facilities offers a valuable extension of the research environment, enabling rapid prototyping and integration of experimental systems. Overall, the laboratory is equipped only for simple measurements and assembly tasks, lacking advanced instrumentation or specialised facilities typically found in university research centres or high-end industrial R&D environments. The current setup supports CVS's mission but would benefit from further investment to enhance its capacity for more complex and internationally competitive research. Based on the available resources, the infrastructure is assessed as poor.

Development potential

Score 2: adequate

CVS plans to expand its role as a specialised applied research and technology development unit over the next evaluation period. Building on its interdisciplinary expertise in aerospace engineering, cryogenic and vacuum systems, microwave-assisted drying, and industrial biotechnology, CVS has developed a research strategy. The unit will continue to prioritise TRL advancement and international collaboration, particularly in space environment simulation and testing, cryogenic technologies, and microwave-assisted drying. New research directions are being pursued, including the integration of artificial intelligence for sublimation control, plasma systems for propulsion and drying processes, and the study of cryogenic material behaviour under deep-space conditions. However, the development potential is rated only as adequate because the current strategy is overly broad and fragmented. CVS seeks to expand simultaneously in multiple complex domains without clear prioritisation, which risks diluting resources and focus. For a small SME with limited infrastructure and heavy reliance on EU project funding, this approach will be difficult to implement successfully. Without narrowing its scope and concentrating efforts on a few strategic areas, CVS may struggle to achieve meaningful progress or international competitiveness.

CVS aims to attract early-career researchers, engineering students, and doctoral candidates by offering hands-on experience in high-tech R&D projects. The unit has experienced significant growth in staff over the past five years. To sustain this growth, securing additional research funding will be essential. CVS currently relies heavily on EU-based funding, and a clear strategy is needed to diversify and stabilise its financial base. Collaboration with Latvian universities remains limited, reducing opportunities for regional integration. Without stronger collaborations, CVS may struggle to enhance its international visibility and fully realise its scientific potential.

Potential to offer doctoral studies

Under Latvian law, a doctoral degree can only be awarded by accredited higher education institutions. Organisations that are not licensed as educational institutions, such as CVS, cannot grant doctoral degrees. Consequently, CVS cannot offer its own doctoral education programme. While the unit has engaged in limited joint doctoral initiatives with institutions such as Riga Technical University (RTU), these collaborations have remained modest in scope and impact. To enhance its contribution to doctoral education, CVS could explore opportunities to host external or industry-based PhD students by integrating them into ongoing research activities. Realising this potential would require a clear strategy and stronger academic partnerships. To play a more substantial role in doctoral training, CVS must establish a focused strategic framework, secure sustainable funding, and ensure consistent supervisory capacity. Without these foundational elements CVS's involvement in doctoral education is likely to remain peripheral.

Alignment with the Smart Specialisation Strategy

CVS shows alignment with Latvia's Research and Innovation Strategy for Smart Specialisation (RIS3), with research activities that correspond to several of its priority areas. These include smart materials and engineering systems, information and communication technologies (ICT), and biomedicine and biotechnology. Work in aerospace, cryogenics, vacuum systems, and engineering technologies reflects aspects of the RIS3 focus on advanced materials and technologies. CVS's sublimation-based applications in food, pharmaceutical, and biotech sectors relate to RIS3 goals in biomedicine and the bioeconomy. The integration of ICT tools, such as machine learning and automation, also supports RIS3 objectives in digital transformation. While the thematic scope is broad, CVS contributes to RIS3 implementation through interdisciplinary research and selected collaborations with industry and academia.

Continued development of strategic partnerships and clearer research focus could strengthen its role within the RIS3 framework.

Conformity with state scientific and technology development

CVS shows alignment with the Science, Technology Development, and Innovation Guidelines. Its applied research and technology development contribute to industrial innovation and commercialisation, supporting Latvia's transition toward a knowledge-based economy. CVS has participated in EU-funded projects and works in areas that correspond to RIS3 priorities, such as smart materials, biomedicine, and ICT. The unit's contributions to niche technological domains and collaboration with industry reflect alignment with national goals.

Recommendations

CVS has demonstrated capabilities in applied research and industrial innovation. However, to enhance its scientific standing and long-term development, several strategic improvements are necessary:

- The Expert Group recommends that CVS significantly increase its publication output and prioritise publishing in reputable, peer-reviewed international journals. The current publication profile is limited and concentrated in journals of questionable academic standing, which restricts the unit's scientific visibility and impact.
- The Expert Group recommends that CVS develop a focused research strategy. The current thematic scope is too broad for a small research unit and risks diluting both expertise and resources. A clearer prioritisation of research areas would enable deeper specialisation and higher-quality outcomes.
- According to its self-assessment, CVS has experienced notable growth over the past five years, strengthening its staff and expanding its technological capabilities. However, to increase its societal impact and research depth, the unit would benefit from integrating industrial PhD students and expanding international collaborations with both universities and companies. If CVS intends to grow as a research-driven organisation and reduce its reliance on production-based revenue, the Expert Group recommends forming a strategic partnership with an academic institution. Such an alliance would provide access to doctoral training, enhance scientific quality, and increase international visibility, which are key factors for sustainable growth and competitiveness.

E_7 Riga Technical University Faculty of Civil and Mechanical Engineering

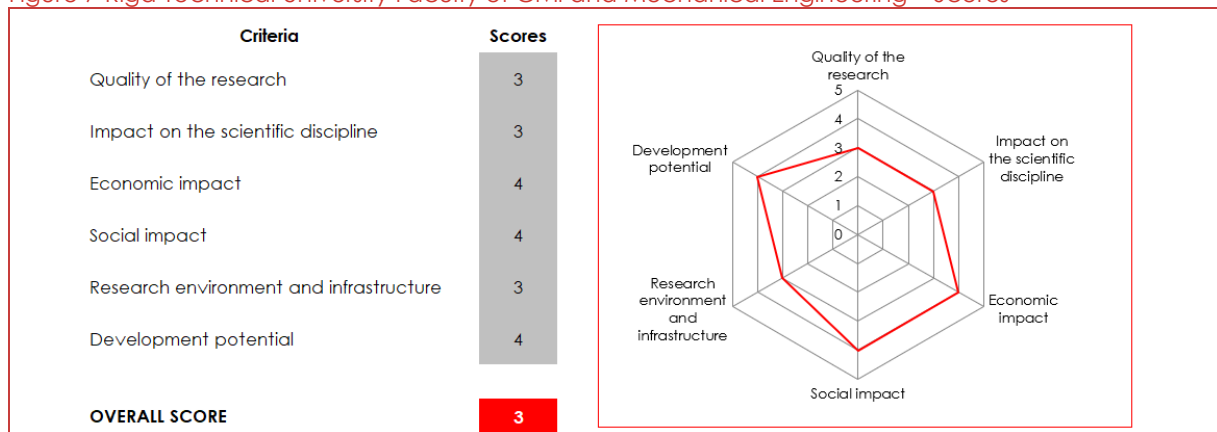
2.2.13 The unit

The Faculty of Civil and Mechanical Engineering (FCME) is a part of Riga Technical University. It was established in 2024 through the merger of the Faculty of Civil Engineering and the Faculty of Mechanical Engineering, Transport, and Aeronautics. Its vision is to serve as a forge of leading experts in the field, providing internationally competitive, high-quality research and education, fostering technology transfer and innovations, and driving the development of a safe, digital, and sustainable future. FCME organises its research around six main research directions: high-performance materials and structures, sustainable building materials, energy-efficient engineering systems, civil and transportation engineering, health technologies, and aerospace engineering. The faculty emphasises interdisciplinary collaboration and international partnerships to enhance its research impact.

2.2.14 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 7 Riga Technical University Faculty of Civil and Mechanical Engineering – Scores



Overall score

Score 3: good level of research

The Faculty of Civil and Mechanical Engineering (FCME) has made significant progress over the last assessment period to become a leader in research that embraces circular economy, climate change, environment, and healthcare – aspects that are important not only to Latvia, but also to the international community. Protective clothing and innovative asphalt concrete research are just some of the success stories. The Expert Group notes an increased research budget, more international and national collaborations, practical innovations, preservation of cultural heritage, contributions to policy planning and evaluation, as well as participation in editorial boards of international journals. The economic and societal impact is very good, demonstrating a clear importance for national industries, high involvement with science communication activities as experts supporting policy making.

However, despite significant progress made since the previous evaluation, the number of PhD students and postdocs, together with the level of funding per FTE member of research staff (which increased from €57.3k/FTE in 2019 to €140.7k/FTE in 2024), is still below that expected of an international player. A significant increase in collaborative international research projects is good, but the unit does not lead any of the consortia and does not demonstrate a significant contribution to international research. The research unit demonstrates a clear focus on publishing in high-quality journals, with an increasing share of outputs appearing in reputable outlets; however, the number of Q1 publications remains relatively low, and the field-weighted citation impact is below the world average.

The Expert Group sees high potential for the unit to develop into a strong international player, particularly given its supportive research environment and the considerable opportunities for collaboration within the faculty, following the merger of civil and mechanical engineering.

Quality of Research

Score 3: good

Overall, FCME is a strong national player with an increasing international recognition. The Expert Group commends the improvements in research quality. Research at the FCME focuses on high-performance materials and structures, sustainable construction materials, energy-efficient engineering systems, civil and transportation engineering, health technologies, and aerospace engineering.

The unit has increased its research budget since the last evaluation period. Notably, 64% of the unit's research budget stems from third-party funding. The average funding attracted per one FTE of academic research personnel has nearly tripled since 2019, reaching ~140k/FTE in 2024. However, the composition of the unit's research budget over the evaluation period suggests that the increase comes particularly from the national competitive research projects and contract research, which almost doubled. The budget of international competitive projects is not as high. What is noteworthy is the limited activity in Horizon projects, compared to other international funding sources such as ERA-NET and Interreg. The self-assessment report mentions six Horizon projects, most with a low- to -modest budget, and only one project with a higher budget (CELLFIL ~€0.59m).

According to publications records, the top research niches are in construction materials, structural engineering, and biomedical engineering. Researchers of the unit have published the results of their research mostly in international journals (e.g., Journal of Materials Chemistry A; Renewable Energy; Science and Technology of Advanced Materials; Journal of CO2 Utilisation), as well as in conference proceedings. During the evaluation period, FCME produced 1,164 Scopus-indexed publications, with an average of 2.21 publications per FTE member of staff, which is a low value. The total number of annual papers has been shrinking, but the percentage of papers published in Q1 journals has tripled since the previous evaluation period. This indicates a stronger focus on quality. Also, the percentage of open access publications has been steadily increasing, with about 60% of publications being published open access. However, there is room to further increase the number of high-level publications, as a share of one quarter of Q1 journal publications is still on the lower side in international comparison.

Training provided for doctoral students has been satisfactory, but the number of defended doctoral dissertations normalised per faculty member is low (seven in 2024). The production of doctoral dissertations is moderate when normalised per unit. The innovation level is good, as illustrated, e.g., by the development of asphalt concrete modified with recycled tyre rubber, opening a new research direction in the Baltic countries.

Impact on scientific discipline

Score 3: good

FCME is a strong national player with increasing international recognition. The unit has made considerable efforts since the last evaluation to improve its international visibility. It occupies a stable position in the international scientific community and is considered a respected centre of competence. Research collaboration at the national level is strong (e.g., joint participation in international projects, co-authorships), and partnerships with foreign institutions have been steadily increasing. Particularly successful collaborations have been conducted in the areas of material engineering, material testing, civil, mechanical, and medical engineering. The unit's

international collaboration rate is high, and about 47% of the publications are co-authored with collaborators from Europe, the USA, and Asia.

The unit has increased the number of international projects. FCME participates in 39 international projects under Horizon, Interreg, and ERA.NET. However, the projects in which they take up coordinator functions tend to be smaller and involve less competitive funding streams (e.g., ERA-Net, Interreg Baltic Sea Region, EIT RawMaterials, NATO, Digital Europe Programme), and there is no coordination of Horizon projects.

The impact of the research can be strengthened, as current bibliometric indicators suggest that its publications perform below the international average in terms of citation impact (e.g. FWCI is 0,93 and thus below the world average of 1. The research output certainly demonstrates consistent productivity; its reach and recognition within the global scientific community have room for improvement. Also, there is no even distribution of citations across publications, but only a small number of papers are highly cited. Enhancing the quality, visibility, and dissemination of research through continuing efforts of publishing in higher-impact journals, improving international collaboration, and promoting open access will contribute to improving the unit's overall research impact and standing.

FCME members serve on the editorial boards of international journals, such as the Journal of Sustainable Architecture and Civil Engineering, Mechanics of Composite Materials, Journal of Mechanics of Advanced Materials and Structures, Applied Composite Materials, and Frontiers in Energy Efficiency. This activity helps FCME staff keep abreast of the latest developments in their respective fields.

Economic impact

Score 4: very good

The research of FCME is very important for the economy, contributing, according to the self-assessment report, 0.5% to the national GDP. The unit's interactions with the private sector stand out in terms of their extensive and dynamic nature.

Collaborations with the industry are at a very good level. The unit completed over 160 industry-focused research projects, attracting €3.5m in funding. Industrial collaboration included leading companies, such as Primekss, Latvian State Roads (LVC), Latvian State Forests (LVM), and AirBaltic, which strengthened local competitiveness by fostering innovation. Its research activities are closely linked to the needs of the Latvian industry, which provides, with a few exceptions, topics for PhD students.

FCME registers several national (and a few European) patents on an annual basis. It developed 16 prototypes showcasing practical applications of their research and established a 3D Concrete Printing Laboratory - the first such lab in the Baltic region. The establishment of 10 spin-offs and start-up companies, as well as the two industrial PhDs, is a positive aspect.

FCME staff serve on several national and international advisory boards, including CERN, International Federation for Medical and Biological Engineering, International Organisation of Medical Physics, European Protective Clothing Association, American Society of Heating, Refrigerating and Air-conditioning, and Institute of Professional Representatives before the European Patent Office. While the efforts are commended, the membership numbers in committees and scientific advisory boards of non-academic entities are average, in an international perspective.

Social impact

Score 4: very good

The research of FCME is important for society; the unit's interaction with the public and policy makers is at a very good level. The unit's interaction with the public sector and society supports the practical implementation of technological solutions.

In its research, the unit emphasises innovation that benefits society in various ways, such as the design of concrete for hazardous waste management, the development of ecological fibre composites, the transformation of waste into high-performance 3D printable cementitious composite material, and activities embracing 'circular economy', environmental, and energy issues.

Public engagement initiatives involved over 1900 science communication events, such as Open-Door Days, European Researchers' Night, and STEM-focused programs. Initiatives like the Children's and Youth University, Latvia's Shadow Day, as well as "Back to University," further promote STEM education and professional careers. FCME research also makes a cultural impact. Research on sustainable development supports the protection of Latvia's cultural and natural assets. It is highly commendable that FCME researchers applied AI, 3D scanning, and photogrammetry to document and preserve architectural and cultural landmarks. Examples include 3D scanning of 20 historic palaces in Riyadh, and historic churches in Ukraine - contributing to efforts of safeguarding architectural heritage in conflict-affected regions. Researchers from FCME are sought-after experts on the European and national and international level to advise policy makers in the fields of biomedicine (e.g., also drafting EU directives), industrial policy, energy policy, waste reduction and sustainable material use, and meteorology policy.

Research environment and infrastructure

Score 3: good

Overall, the unit is a strong national player, able to provide a research environment that is comparable with international academic institutions in civil and mechanical engineering. The work is conducted mainly in laboratories with good - and improving - quality equipment, although the limitations of capacity for testing on a large scale in the structural engineering discipline are notable.

The amalgamation of the civil and mechanical engineering into one faculty happened briefly before the evaluation in 2024 and has yet to unfold its full potential. It certainly encourages expanding the already high disciplinary diversity of authors and multi-disciplinarity in research. Discussions with staff and stakeholders supporting FCME showed that the merger of the two faculties was viewed as a very positive step, with good potential for future developments.

The numbers for academics, researchers, administrative and technical personnel in the unit are at a good level. The organisation of the management of research is described well, and the same holds for the long-term strategic and financial resource planning. The merger between civil and mechanical engineering faculties resulted in a reduction in the number of research-active staff, but this reduction was also due to staff coming up for retirement. Despite that, research performance has increased, with base research funding rising significantly.

By 2030, FCME aims to increase the share of international researchers to 25% and achieve full employment for PhD students. Regular evaluations of academic performance ensure alignment with academic, scientific, and organisational competency standards. Currently, the ratio of BSc students per FTE member of research staff is 1.39 and Master students 3.69. Both of these figures are lower compared to earlier years. Currently, the ratio of students per FTE member of research staff is low, compared to international standards.

FCME encourages participation in international conferences, collaborative projects, and programs like COST Short-Term Scientific Missions (STSMs). In terms of professional development, it offers training programmes, seminars, workshops, and matchmaking events like Science Breakfast to support career development. Long-term support focuses on sustainable academic renewal through tenure-track opportunities and professional development programs.

FCME boasts a fully renovated facility with a total area of 8,256 m², half of which is laboratory space. Its laboratories are equipped with 3D concrete printing equipment, FLIR A6752SC high-performance thermal imaging camera, a scanning electron microscope Jeol JSM-IT200, additive manufacturing equipment for metals, and a cryogenic infrared vacuum chamber for space simulations. The 3D Concrete Printing Laboratory, Personal Protective Equipment Laboratory, and Building Materials Laboratory serve a range of research activities, including material manufacturing, mechanical testing, and biomedical engineering. These facilities are adequate for most FCME needs, and partnerships with other institutions also provide access to rare and maintenance-intensive equipment.

FCME ensures access to its research infrastructure through a centralised Science Service Register, facilitating an efficient use of equipment. Technical staff and data stewards provide support for the operation and maintenance of research facilities. Regular training sessions are conducted to ensure optimal use of equipment and adherence to ethical standards.

Notwithstanding the strengths, the unit's capacity for large-scale structural testing remains limited, which may constrain its ability to compete for certain types of international research projects and industry contracts in structural engineering. In addition, while research performance has increased following the merger, the currently low student-to-research-staff ratio raises questions about long-term sustainability and the effective integration of research and education as the faculty continues to develop its new organisational structure.

Development potential

Score 4: very good

The unit has a reasonably clear vision for the future and well-defined plans to initiate new research directions. Strengths, weaknesses, opportunities, and threats are realistically assessed. Of particular interest will be the realisation of potential interdisciplinary and multidisciplinary collaborations of civil and mechanical engineering research.

Research conducted at the FCME has a good component relevant to national needs. The future research directions are aligned with the following priorities: space and defence technologies, additive manufacturing, and CO₂ capture and storage. FCME's total research funding increased to €37.7m, with competitive funding outweighing base funding by approximately 30%. However, the ratio of competitive funding to state funding is average. Involvement in international collaboration projects and networks is evolving. The fact that a good portion of international funding comes from European projects is positive. The Expert Group commends setting up the Science Support Fund in 2024 with a budget increase from €80K in 2024 to €155k in 2025, as well as the increase in contract research funding that reflects FCME's role in applied research and innovation.

Looking ahead, over the next 5-10 years, the unit has a good potential to strengthen its position in the international scientific community as a convincing actor and a trustworthy partner within international collaboration networks. The size of the unit is sufficient, but its ability to attract high-level doctoral students and scientists from abroad is limited. The Expert Group recommends continuing, already established efforts from FCME's Science Support Fund, which incentivise staff to produce high-impact publications and successful grant applications. Also, offering competitive salaries, relocation support, and integration pathways are good initiatives to attract top researchers. Recruitment of foreign tenured professors and Latvian diaspora

researchers strengthens FCME's international collaboration and diversity. A welcome development is the appointment of staff in charge of international collaboration, as is the introduction of a tenure professorship.

Potential to offer doctoral studies

FCME has a good potential to offer doctoral studies, supported by its infrastructure and research environment. The unit offers doctoral study programmes in: Civil Engineering, Heat, Gas, and Water Technology, Mechanical Engineering and Mechanics, and Transport Engineering. It is encouraging that, during the evaluation period, the number of employed PhDs gradually increased, reaching 58% of all PhD students in 2024; however, there is room for further improvement. The unit has a good potential to strengthen its PhD programmes; this is supported by the scale of research and the quality of the infrastructure in some of the disciplines covered by the unit. PhD students interviewed by the Expert Group said they feel well supported, have frequent contact with their supervisors, and are very positive about their work. They discuss their future prospects with supervisors and are able to travel to conferences and visit international institutions. Partnerships with top universities and research institutions provide doctoral students with mobility opportunities and knowledge exchange.

The unit also outlined support structures for early-career researchers, including workshops on grant writing, support for publishing in high-impact journals, research communication, and technical training in advanced methodologies. It also includes mentoring programmes with senior members of the faculty and alumni.

FCME has invested €16.8m in upgrading its research environment, including state-of-the-art laboratories and equipment. It has access to shared facilities and digital platforms to enhance cost efficiency and provide access for doctoral candidates.

Alignment with the Smart Specialisation Strategy

FCME research aligns very well with Latvia's Smart Specialisation Strategy (RIS3), in terms of supporting economic transformation through innovation, focusing on higher added value and resource efficiency. The unit engages in innovation-driven research, addressing societal challenges, and advancing sustainable development. FCME develops high-value-added materials, such as nanocomposites, self-healing concrete, and foamed geopolymers. These support resource-efficient construction and sustainable manufacturing, addressing RIS3 goals of green innovation and industrial modernisation.

Other activities, such as integration of Building Information Modelling (BIM) and geospatial technologies, drive digital transformation in construction and infrastructure development, aligning with RIS3's focus on ICT-driven progress. Research into renewable energy systems ensures sustainable energy solutions and environmental conservation. Projects like Recycling Waste into High-Performance 3D-Printed Cement Composites exemplify a contribution to a reduced environmental impact. The development of eco-friendly materials (bio-composites) from industrial waste promotes sustainability in construction, also in line with RIS3 goals for bioeconomy and circular economy. The contribution to renewable energy integration, energy-efficient building systems, and UAV technologies supports the country's transition to green energy and smart mobility solutions.

Conformity with state scientific and technology development

Research of FCME aligns with Latvia's state objectives for scientific, technological, educational, and innovative development. FCME fosters collaboration with industry and the public sector, engages in international projects, and promotes applied research with societal and economic relevance.

Over the assessment period, FCME increased the quality of its research output and international co-authorship, and attracted €19m in research funding, including €6m from international sources. It invested €16.8m in upgrading research facilities, supporting high-impact research and interdisciplinary collaboration. It secured €3.5m in funding for smart technologies, renewable energy, and digitalisation. Further examples of innovation and entrepreneurship include numerous patents (2 European), 16 prototypes and several spin-off companies. It also offers specialised training to help industrial partners remain competitive, aligning education with labour market needs.

Regarding Policy Guidelines for Science, Technology Development, and Innovation 2021–2027, FCME (i) supports the development of research excellence and international cooperation through high-quality publications, global partnerships, and competitive funding, and (ii) increases the capacity for innovation by advancing applied research, registering patents, and collaborating with industry.

Recommendations

The Expert Group has the following recommendations for the FCME:

- The number of publications in high-quality journals should be further increased to strengthen the visibility, international reputation, and impact of the research. The unit has already demonstrated good progress in the assessment period and should continue its pursuit.
- To strengthen the international impact of the research, the unit should aim to take a more proactive role in leading and coordinating international research consortia, especially Horizon Europe Projects. While participation in international projects has been improved, assuming leadership positions would further enhance the unit's visibility, influence, and capacity to shape research agendas.
- The initiative of dedicated staff to improve FCME's international links is a good start. Yet, the Expert Group also recommends installing an international advisory board for the faculty to provide continuous external feedback on the advancement of the strategic goals in times where changes such as the merger of the faculty or staff changes due to the retirement of senior staff are still unfolding.
- Improving the attractiveness of academic career paths requires offering internationally competitive remuneration and clearer progression opportunities for PhD graduates and postdoctoral researchers. Strengthening these areas will help retain talent within academia, support a sustainable pipeline of researchers, and enhance the overall research capacity of the institution.
- The Expert Group commends FCME for their efforts to increase PhD numbers, but this number, per FTE research-active staff, needs to be even higher to match that found in quality international institutions. FCME could reconsider reducing the scope of the compulsory requirement for PhD students to undertake undergraduate courses, as part of their doctoral studies. This would enable them to concentrate on their research.
- Encourage the development of mechanisms that strengthen the independence of PhD research from industrial interests. This could include providing complementary institutional or public funding for doctoral projects that go beyond immediate industrial interests.
- The unit should continue to invest in upgrading laboratories and advanced scientific equipment to maintain its attractiveness as a partner for industry collaborations and to support cutting-edge research. Strengthening cooperation between mechanical and civil engineering holds strong potential to mobilise in-house capacities for developing new research infrastructures, as demonstrated by the successful example of the 3D concrete printer.
- The Expert Group suggests addressing the current limitation of facilities for large-scale structural testing. The unit has already explored the possibilities of acquiring new large-scale testing facilities and engages in collaboration with institutions. However, improving their in-house facilities will significantly enhance the unit's research capabilities and international competitiveness.

E_8 Riga Technical University Faculty of Computer Science, Information Technology and Energy

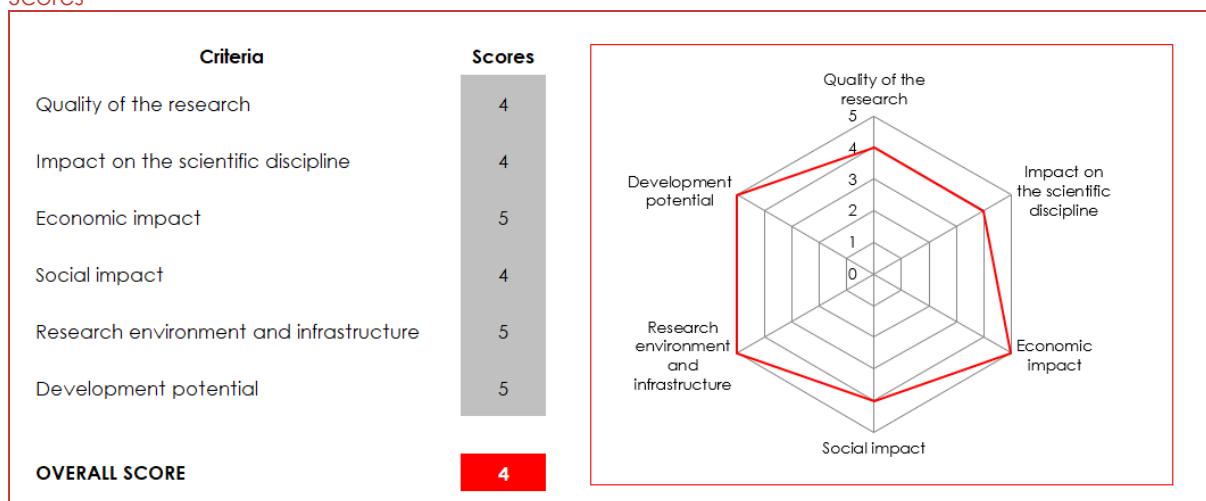
2.2.15 The unit

The Faculty of Computer Science, Information Technology and Energy (FCSITE) is a faculty within Riga Technical University, which was established in 2024 through the consolidation of four faculties. FCSITE's vision is to lead world-class scientific research, drive sustainable innovation, and produce graduates who are internationally competitive. FCSITE is committed to both fundamental and applied research. It organises the research in six institutes each focusing on strategic research directions: future-driven energy systems and power electronics; photonic technologies, microwave, and advanced electronics; complexity handling in software/systems engineering and multi-domain applications of artificial intelligence; pervasive data processing, cybersecurity, and massive computational intelligence; digital humanities, e-learning, language data and technologies; advanced mathematical modelling, complex system dynamics, and particle physics. FCSITE hosts the Latvian Electronic Equipment Testing Centre.

2.2.16 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 8 Riga Technical University Faculty of Computer Science, Information Technology and Energy – Scores



Overall score

Score 4: very good level of research

The Expert Group awards the RTU Faculty of Computer Science, Information Technology, and Energy (FCSITE) an overall score of '4', indicating a very good level of research. The unit is a strong international player in research, with high impact through participation in many Horizon 2020 projects and solid citation statistics (19,174 citations between 2019 and 2023). Notable is the good mix of fundamental and applied research. The unit has an outstanding economic impact through its central role in Latvia's ICT sector, for instance, as a seedbed for numerous start-up companies, and its business-friendly management. The social impact of the staff's research and other activities is very good. The unit employs a high proportion of female staff by international standards (33% of female staff). The research is very well managed, with a well-thought-out long-term strategic plan for personnel as well as infrastructure. The unit hosts an impressive number of modern, well-equipped laboratories that cover a wide range of systems for basic and applied science. The Expert Group assesses the development potential as excellent, due to past performance as well as competent and forward-looking management.

To reach the level of 'outstanding,' however, additional improvements are required, such as a more uniformly strong publication record among the subfields, as discussed in the Quality of Research paragraph below. Moreover, European units at the highest level of research typically also host researchers successful in receiving ERC grants.

Quality of Research

Score 4: very good

The Expert Group scores the quality of research as '4', recognising FCSITE as a strong international player. Particular fields of research, such as those investigating infrared and THz communication, are at an international top level, published in leading journals such as Nature and Nature Communications. However, in other fields, based on the publication record and the judgment of the Expert Group, the research performance is good but still evolving.

Notably, the Expert Group assessed that a substantial portion of the research focuses on high-quality fundamental research alongside applied subjects, creating the fundamental/applied balance expected of an internationally highly regarded academic institution.

Overall, the unit has demonstrated a remarkable increase in competitive research funding acquisition over the evaluation period. This growth serves as a clear indicator of the unit's research quality and international recognition. Notably, the volume of international funding has expanded substantially. The unit participated in 114 international projects, and its budget under the EU Framework Programmes has increased by an impressive 684% since 2019. Particularly noteworthy is the unit's success in securing three major projects (EXPEDITE, H2 SEAS, TED4LAT), each with funding exceeding €1 m, alongside several other projects with high funding volumes above €300k (e.g., MOPO, MEDUSA, HyWay, FEMaLe, CHARM). This demonstrates the unit's reputation as a reliable and capable partner that can assume significant responsibilities in large-scale consortia.

While the unit has been particularly successful in attracting EU Structural Funds, it should be mindful of the temporary nature of these funding sources. The Expert Group recommends leveraging the unit's recent success and enhanced visibility to further diversify its international funding portfolio, specifically by targeting funding opportunities such as those from the European Research Council (ERC). ERC grants are not only highly competitive and financially substantial but also serve as prestigious quality marks within the international research community. The Expert Group sees considerable potential within the unit to develop competitive ERC proposals, given its strong track record of securing international research funding and demonstrated capacity to lead large-scale projects. However, the Expert Group also emphasises that successful ERC submissions typically require sustained institutional support, including targeted mentoring, proposal development assistance, and access to internal review mechanisms. Strengthening these support structures would help translate the unit's evident research excellence into high-level ERC applications and further enhance its international visibility and competitiveness.

There is still room to further develop the unit's private-sector funding. Most projects with industry involvement are below €100k and of short duration. The Expert Group sees potential in strengthening this dimension, e.g., by industry-funded doctorates. Given the limited size of the Latvian market, the unit may also consider building stronger partnerships with non-Latvian industrial actors, capitalising on its well-developed research infrastructure, which represents an attractive asset for non-academic collaborations.

Regarding the publication record during the evaluation period, there is a slight trend of increasing the number of Q1/Q2 publications and a robust trend of decreasing non-Scopus/WoS-listed publications. These trends indicate that a commendable effort has been made to decrease the number of publications in low-ranked venues. The next step is more challenging, however. It should be noted that the Q1/Q2 measure is a crude measure of

quality; the top publications are, of course, Q1, but so are also many of modest reputation and, unfortunately, even many with a questionable reputation due to an inconsistent and too-fast review process. To uniformly reach the highest ('global leader') level of quality, the unit would need to aim for research that can be published more consistently in the publication venues of the highest reputation, typically top journals.

Impact on scientific discipline

Score 4: very good

The Expert Group scores the impact of FCSITE on the scientific discipline at '4', recognising the unit as a strong international player. FCSITE participates in a large number of Horizon Europe and other externally funded international projects, which indicates that the unit is an internationally highly regarded collaboration partner. Several researchers are active, also in leadership roles, in international networks and societies. FCITE has an impressive presence in international competitive research programmes, for instance, 22 EU Framework projects.

The unit currently serves as coordinator for three Horizon Europe projects, a clear indicator of the confidence international partners place in it. Successfully managing and coordinating such projects demonstrates the unit's organisational capacity, leadership, and reliability in complex international consortia. The Expert Group considers this a strong quality mark and encourages the unit to further expand its role as coordinator in future European projects. Taking up additional coordination responsibilities will not only enhance the unit's strategic influence but also help position it as an agenda-setting, top-performing research unit at the European level.

The unit reports that, compared to 2013–2018, the number of international publications increased by 86%. Another indicator of the impact of FCSITE is the good citation statistics, both in terms of average citations and, most notably, in the number of publications in journals that fall within the top 10% most cited in their subfield. Moreover, 47% of the FCSITE publications are available in open-access formats.

The Expert Group notes positively that the unit actively contributes to international conferences and workshops, such as OFC, ECOC, SiPhotonics, IEEE, and SPIE conferences, thereby enhancing its research visibility and engagement with the global academic community. It is commendable that several of these events have been (co-)organised by researchers from the unit, reflecting their strong standing within international professional networks. At the same time, the Expert Group sees potential to further strengthen this dimension by organising more high-level international conferences and workshops in Riga. Such activities would not only increase the unit's international visibility but also position it more prominently as a core hub in its field.

The Expert Group acknowledges and commends the unit's ongoing efforts and outlined strategies to strengthen internationalisation, which represent a solid foundation for the unit's future strategic development. Looking ahead, the Expert Group thinks that the unit should further pursue opportunities such as ERA Chairs and Horizon Europe Twinning initiatives, which can attract high-level researchers, foster the formation of integrated international teams, and further boost both the research capacity and international visibility of the unit.

Although the Expert Group finds the impact on the scientific discipline from the unit to be very good, to reach the level of '5,' 'outstanding,' the institution should, according to the evaluation methodology, be regarded as a 'Global leader.' That is, the research output should be published in the leading forums of the respective discipline, which is not uniformly the case here. Moreover, the unit should have a considerable impact on the development of the discipline, a very challenging requirement, and something that the Expert Group finds has not been demonstrated.

Economic impact

Score 5: outstanding

The Expert Group scores the economic impact of the unit at the top grade '5,' that is, outstanding. The self-assessment report, as well as the impressions from the site visit, make it clear that the unit plays an absolutely central role in Latvia's ICT sector. For instance, FCITE reports that over 100 startups involve staff and students from the unit. The unit shows an upwards trend for prototypes, computer programmes, and algorithms and has increased its patenting activity.

In conversation with the public and private collaboration partners, it was pointed out that the present management shows a 'pro-business' attitude, trying to avoid hampering partners with bureaucracy as much as possible. The unit demonstrates a strong commitment to improving support structures for commercialisation, which is commendable. It maintains close contact and active exchange with relevant Latvian industry representatives (e.g., Accenture, LMT, Augstsprieguma tīkls), partners with professional associations such as LETERA, IT clusters, IEEE, and ACM, and organises industry-focused events, including European Researchers' Night and RTU's Industry Day, and exhibitions. These activities highlight the unit's proactive approach to bridging research and industry and its efforts to increase the societal and economic impact of its research outcomes.

There is room to further strengthen the unit's already good industry collaborations, not only by transferring knowledge but also by securing additional funding from private sources. For example, the unit plans to expand industry-funded doctoral programmes, which represents a promising step in this direction. Moreover, the unit could explore opportunities to generate more revenue from non-Latvian companies, leveraging its research infrastructure and international networks to attract partnerships beyond the national market.

Social impact

Score 4: very good

The Expert Group scores the social impact of the unit at '4,' very good. FCSITE partners include major Latvian associations in the ICT sector, the actuary, and Open Technologies. Also, FCSITE staff serve as board members in partner organisations in Latvia's ICT sector.

The unit actively develops practical solutions with societal impact, including energy storage prototypes, portable devices for skin cancer detection, innovative algorithms, OFC sources, hybrid optical amplifiers, Open-RAN technologies, AI-based plagiarism detection, and multi-robot systems. These efforts demonstrate the unit's capacity to translate research into tangible applications that address real-world challenges and contribute to technological and societal advancement. Moreover, there are research directions addressing challenges in the digital domain for youths through a research project funded by the Latvian Council of Science. There are also outreach initiatives to communicate public awareness of science and technology.

The unit has significantly enhanced its efforts to communicate research to the public, with outreach activities increasing from 88 to 362 activities over the evaluation period. It aims to address a broad spectrum of target groups, including current and prospective students, policy makers, and the general public. The unit employs a variety of digital communication and media channels, such as YouTube channels, an in-house magazine to update students and staff, and collaborations with media outlets to raise public awareness of its scientific achievements, including contributions to television channels and educational programmes. These initiatives reflect a proactive and diverse approach to science communication and public engagement.

Researchers from the unit also function as experts for policy advice, contributing to initiatives such as shadow economy assessments, European Maritime and Fisheries Fund projects, and programmes to produce healthy planting material and test innovative crop-growing methods. Its expertise is reflected in policy-relevant publications at both the national and European levels. Nationally, this includes outputs from state research programmes on topics such as quality management in healthcare, ICT solutions for business resilience, ICT tools for student monitoring, and monitoring learning ethics in higher education. At the European level, the unit has contributed to initiatives such as the JRC Resilience Assessment of Critical Infrastructures, demonstrating its capacity to provide evidence-based policy input and guidance beyond the national context.

Even though the unit's central mission is science and technology, it has nevertheless demonstrated a moderate cultural impact, measured in terms of the number of projects and funding. This impact has been demonstrated through initiatives such as Old Latvian text conversion, edutainment digitisation, and AI-based photo restoration. Another example is the use of Digital Twins to protect endangered cultural heritage. While these activities blend technology with cultural preservation and contribute to national identity, their overall scope and reach of the activities remain limited, indicating room for further development in this dimension.

Research environment and infrastructure

Score 5: outstanding

The Expert Group scores the research environment and infrastructure of the unit at the top grade '5,' outstanding. The self-assessment report, as well as the impressions at the site visit, clearly show a well-functioning management of the unit's research, and a well-thought-out long-term strategic planning of human resources as well as research infrastructure.

The self-assessment report specifies an impressive number of 19 specific laboratories/infrastructure centres that constitute the unit's physical infrastructure for experimental testing and research. As is clear from the report as well as from the impressions at the site visit, these laboratories are well-equipped, modern, and cover an impressive range of systems for basic as well as applied science. These labs are well aligned with the unit's scientific objectives and long-term strategies. FCSITE also provides computational resources at a high international level in terms of the RTU High-Performance Computing (HPC) centre and GPU hardware. The unit is a stakeholder of the EuroHPC Joint Undertaking and EuroCC. Also, state-of-the-art software tools, including MATLAB and VPIphotonics, and data management systems are provided.

The unit has made significant efforts to create a good research environment. The Expert Group commends its efforts to enhance diversity and inclusivity. The unit demonstrates a strong commitment to gender balance, with approximately 33% of the academic staff being female, which is unusually high in a technical field. The unit has also increased international representation, with 9% of staff coming from abroad. The expansion of courses taught in English has made it attractive for student mobility, with about 250 incoming students already participating. The staff age profile has been optimised to ensure a sustainable distribution, supported also by the introduction of a tenure-track system. Overall, the unit demonstrates a strong commitment to supporting early-career researchers through initiatives such as mentorship and guidance, structured career progression, and integrated research opportunities, thereby fostering a dynamic and supportive research environment.

Development potential

Score 5: outstanding

The Expert Group scores the development potential of the unit at the top grade '5,' outstanding. The self-assessment report, as well as the impressions from the site visit, indicate a

very well-functioning unit, both in terms of management and actual accomplishments. The last evaluation period has seen substantial improvements in funding, a noteworthy effort to improve the quality, rather than quantity, of scientific publications, and a build-up of state-of-the-art experimental facilities. The unit has an impressive participation in competitive international funding, which gives the unit's researchers a good opportunity to increase the unit's international impact.

The unit hosts quite a large number of PhD students, and the statistics for defended doctoral dissertations are good, considering the difficulties with financing and, therefore, the need for a complementary income, which often seems to have slowed down PhD education in Latvia.

The 'outstanding' grade means 'a high potential to become a global leader,' which is an aim not easy to reach, but the Expert Group holds this as possible, at least for a selected number of research groups. For this aspiration to materialise, however, it is important that the FCSITE can offer internationally competitive salaries and benefits to be able to attract high-level international staff and students.

Potential to offer doctoral studies

The unit hosts quite a large group of PhD students already, and the throughput is reasonable. However, in some years of the evaluation period, the unit recorded a relatively high number of PhD students exceeding the normative time to completion (e.g., 100% in 2022). The Expert Group notes the improvement (58% in 2024) and expects the changes in the Doctoral School system to help improve timely completion rates in the future.

The unit demonstrates a range of initiatives to support PhD students and early-career researchers, including mentoring, facilitating access to professional networks, and providing modern research infrastructure. Tailored training and workshops in research methods, grant writing, and publishing further strengthen their skills. In addition, PhD students are given opportunities to gain teaching experience and develop international connections, contributing to both their professional development and the unit's overall research capacity. Due to the high quality of the research and the economic and societal importance of the research fields, the Expert Group considers FCSITE to be an excellent and attractive unit to attract talented students to their doctoral programme. The broad offering of study programmes taught in English is particularly valuable, as it not only attracts a greater number of international students but also helps build a diverse pool of potential PhD candidates. The Expert Group also welcomes the unit's initiatives to apply for Marie Skłodowska-Curie Actions (MSCA) and views the development of joint degree programmes with high-performing international universities as a positive step toward deeper academic integration.

Alignment with the Smart Specialisation Strategy

The Expert Group finds that the research at FCSITE, to some degree, covers all five main priority areas in the Smart Specialisation Strategy. A particular strong part is priority area five, 'Information and communication technologies.' Indeed, the unit serves an absolutely central role in the development of Latvia's ICT sector. In addition to the RIS3 priority areas, the unit pursues research and innovation in biomedicine, medical technologies, and biopharmacy, developing solutions such as machine learning- and AI-based healthcare tools and systems for early detection of skin cancer. The unit also contributes to technological advancements in the defence sector through expertise in relevant technologies such as cybersecurity, UAVs/USVs, and radar systems, exemplified by an EDF (European Defence Fund) funded project on AI for Defence Advanced Intelligence. All this reflects a diverse strategic focus that aligns with both national and European research agendas.

Conformity with state scientific and technology development

FCSITE's objectives as well as performance during the evaluation period are consistent with Latvia's stated industrial policy. The innovation level is high, for instance, in terms of the number of spin-off companies that the research has created. The high level of involvement in international projects is consistent with the aim to 'increase national productivity, exports, and global competitiveness.' As confirmed by industrial partners during the site visit, the management is regarded as business-friendly and is mindful of reducing administrative burdens for industrial partners, again in line with the innovation-specific directions of the policy guidelines.

The unit demonstrates a clear alignment of its strategic orientation with broader policy frameworks, including the Horizon Europe Strategic Plan 2025–2027, the Digital Decade Strategic Roadmap 2030, Latvia's National Development Plan 2021–2027 (NDP 2027), the Sustainable Development Strategy for Latvia until 2030 (SDS 2030), and the Guidelines for Science, Technology Development, and Innovation 2021–2027 (STDI 2027). This alignment reflects the unit's commitment to ensuring that its research and innovation activities contribute meaningfully to national and European strategic priorities.

Recommendations

- To be able to reach the status of 'outstanding' and a 'global leader,' the FCSITE will need to consider offering internationally competitive salaries and benefits, to be able to attract high-level international staff and students.
- The Expert Group recommends that the unit pursue initiatives to increase the stay of visiting researchers and to participate in ERA Chairs and Twinning programmes, as these measures are expected to help attract high-level researchers. Such initiatives would also support the formation of integrated research teams and further strengthen the unit's long-term international collaborations.
- The Expert Group suggests that the unit could establish an international advisory board to provide additional guidance and support for its internationalisation. Such a board could help the scientific board to continuously identify strategic opportunities and accompany the unit in its pursuit to become a scientific leader.
- The Q1/Q2 designation is an imprecise estimate of journal quality, and the Expert Group recommends a directed effort to publish in the real top journals instead of being guided solely by the Q1/Q2 metric. Generally, the top journals offer a comparably more consistently rigorous review process and typically attract higher international interest. An effort to publish in these journals can already be seen by some groups at FCSITE. Note that in some fields of Computer Science, for instance, the focus should rather be on the top-rated international conferences, since these are the venues that internationally may be more impactful than journals. As a guide to what can be considered top journals, the Expert Group suggests consulting classification lists compiled by experts, rather than relying on journal metrics. Such lists are available from several countries, for instance, Norway, Denmark, and Finland.
- The Expert Group recommends that the unit adopt a structured approach to target ERC funding. While Latvia is currently underrepresented in ERC achievements, the unit clearly demonstrates the potential to succeed in these highly competitive grants. Realising this potential will, however, require dedicated and coordinated support from the institution, including mentoring, proposal development assistance, for instance by funding time for proposal writing, and access to internal review mechanisms.
- The Expert Group recommends that the unit intensify efforts to increase private-sector funding. Expanding collaborations with both Latvian and international companies, developing industry-funded doctoral programmes, and pursuing longer-term joint projects could help the unit diversify its funding portfolio. The Expert Group recommends that the unit increase the number of projects in which it serves as coordinator. The unit has already

demonstrated the capacity to manage and lead international consortia, and taking on more coordination roles would not only increase funding but also enhance its standing in the research community, showcasing its thought leadership and strategic influence at the European level.

E_9 Riga Technical University Faculty of Natural Sciences and Technology

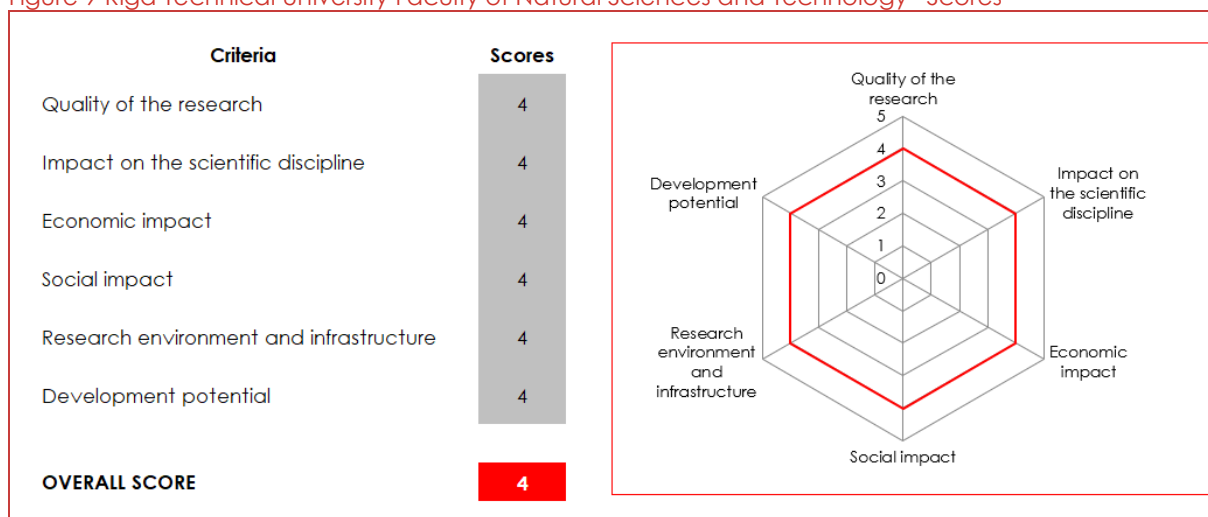
2.2.17 The unit

The Faculty of Natural Sciences and Technology (NST) is a faculty within Riga Technical University. The unit's mission is to "advance knowledge from elementary particles to ecosystems," aiming to enhance scientific excellence and address real-world challenges with interdisciplinary and impactful solutions. In 2024, it was established in its present form, uniting the research groups in five research domains (particle physics and accelerator technologies; chemistry; materials science; environmental engineering and biotechnology and bioengineering) in the same faculty. Cutting across the five main research domains are interdisciplinary research areas focusing on radiation-resistant materials, high-strength composites, advanced detection systems, cybersecurity, and energetic materials. Collaboration patterns include partnerships with international research entities like CERN and participation in European research programmes. The unit's research dissemination plan includes open-access publishing and industry collaborations, ensuring that research outcomes have practical applications and societal impact.

2.2.18 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 9 Riga Technical University Faculty of Natural Sciences and Technology– Scores



Overall score

Score 4: very good level of research

The Expert Group allocated the unit an overall score of '4', rating it as a strong international player. Research by NST possesses a very good standard of quality with an increasing number of high-impact publications since the previous evaluation period and has a significant social and economic impact, focusing on climate and energy policy, environmental protection, and urban sustainability. NST has a strong role at the international level, leading European projects and strengthening research collaborations with CERN, as well as other renowned institutions. The unit actively collaborates with both the private and public sectors, attracting significant funds. During the period 2019 and 2024, substantial investment has been made in infrastructure and institutional development; accordingly, the equipment as well as the research environment is at an international level.

Quality of Research

Score 4: very good

The unit produces high-quality research and demonstrates significant improvements since the last evaluation. The total number of Q1 papers has increased considerably to 51%. The total number of papers in indexed journals and conference proceedings included in Web of Science or SCOPUS databases is 1,692, i.e., on average 282 per year. The publication output per FTE member holding a PhD per year is good, although there remains room for improvement. The quality of submitted full-text articles is very good, research is original, innovative, and clearly contributes to significant new knowledge production.

During the period 2019-2024, a remarkable number of PhD theses (95) have been defended. There is a high number of outputs derived from PhD theses. NST has implemented formal methodological guidelines for the doctoral programs to improve the quality of the thesis outputs. There is a high percentage (~60%) of PhD students who exceed the normative time to degree. Students named the lack of funding opportunities and excessive bureaucracy in the administrative process as core reasons for the delay. During the evaluation period, NST introduced doctoral employment contracts, two years before they were legally mandated, which contributed to increasing the four-year thesis completion rate.

The unit demonstrates an active involvement of academic personnel in Horizon 2020, Interreg, ERANet, COST Actions, and the U.S. National Science Foundation projects, as well as national projects, including state research projects in the field of biomedicine, medical technologies, and pharmacies and the multi-scale laser surface texturing for low ice-friction contacts. NST reported the acquisition of funding worth €54m through competitive research projects on the national and European level. Both base and competitive funding have increased gradually during the period 2019-2024. The ratio of competitive European funds to base funds is 2.25, which reflects the unit's strong international development. The strong international profile is further evidenced by memberships in editorial boards and awards.

Impact on scientific discipline

Score 4: very good

NST's international recognition and impact on the discipline are high. The unit's research outputs are published in top journals (e.g., Nature, The Lancet Oncology, Bioactive Materials), contributing to emerging scientific disciplines and strengthening its international impact. The Field-Weighted Citation Impact (FWCI) is higher than one, indicating a citation impact of the papers above the world average. NST increased its visibility by collaborating with global research institutions in projects funded by Horizon 2020, Horizon Europe, ERA-Net, Interreg, COST Actions, U.S. National Science Foundation, ERC, and CERN.

NST also participates in international research infrastructure networks and actively collaborates with CERN, synchrotrons (SG), and the European University of Technology (EUT+). Both researchers and students participate in and organise international conferences, including the Baltic Polymer Symposium 2023 and the Scandinavian Society for Biomaterials 14th Annual Meeting. Further, staff members act on editorial boards of scientific journals indexed in WoS and SCOPUS. Researchers from the unit received national awards, including the REGISTARS award and the Latvian Academy of Sciences and Corp. Latvenergo Competition "annual award," indicating the institution's strong recognition of scholarly excellence and its capacity to compete at the highest national level. Overall, the unit is internationally recognised in its discipline and is highly regarded as a strong partner, also in coordinator roles, in international research projects and networks.

Economic impact

Score 4: very good

The unit has consistently demonstrated a strong capacity to attract competitive research funding. From 2019 to 2024, it participated in numerous international projects, including Horizon Europe. Researchers of the unit have been the coordinator for several high-impact projects (e.g., BBCE (Coordinator, €30m), CIRCLEUP (Coordinator, €1.3m), I.FAST (Partner, €19m), PESCO-UP (Partner, €10m)), reinforcing its ability to lead large-scale research initiatives. The total amount of attracted funds from international sources is around €36m. This success in securing external funding enables the unit to sustain innovative research and expand its infrastructure.

Through partnerships with leading companies, research findings were turned into commercial products, patents, and successful start-up companies (e.g., Ekodoma, PEOSolutions Lab, MetaboNet, Protium Tech, and Waterson Technologies). In line with the recommendations received during the previous evaluation, the unit has increased its patenting activity, registering 44 Latvian patents and four international patents in the assessment period. The unit has been an active collaborator with the private sector and has also attracted funds (€2.7m) from sectoral public partners and reports on collaborations with several private enterprises through contract research. The unit's collaboration with CERN offers opportunities for local businesses to participate in CERN-related projects, thereby boosting Latvia's high-tech industry. Overall, research of the FNST is very important for the Latvian economy.

Social impact

Score 4: very good

The unit has a very good social impact, and the research at NST is important for society, especially through its research contributions to public health, pollution reduction, and resource sustainability. For example, NST implemented wastewater-based epidemiology to detect viral pathogens, pollutants, and antimicrobial resistance, providing real-time data for public health decision making. This initiative gained recognition for its environmental health monitoring.

The unit aims to ensure its research is accessible to a diverse audience, including industry professionals, policymakers, students, and the public. NST promotes a number of science communication activities, furthering the public understanding of research through social media presence and public engagement. The unit conducts public engagement initiatives, such as Open-Door Days, European Researchers' Night (more than 500 students attend annually), and STEM-focused educational programs.

NST plays an important role in public sector engagement and policy development, in the areas of climate and energy policy, environmental protection, and urban sustainability. To achieve this the unit has put more effort into sharing research findings with the public, raising awareness of scientific advancements and encouraging students to pursue careers in research. The unit also contributes practically, for instance, through the teacher supply-demand tool commissioned by the government and now used for national policy planning. Overall, research of the unit is important for society, and interactions with the public are at a level that is expected of recognised academic institutions.

Research environment and infrastructure

Score 4: very good

Following the 2019 evaluation, NST has made considerable progress in addressing the recommendations, which aim to improve scientific impact, doctoral training, research infrastructure, and international collaborations. One key recommendation was to streamline research areas and optimise the organisational structure to enhance scientific impact. In response, the unit has restructured its institutes. For example, three chemistry-related institutes

have been merged into one Institute of Chemistry and Chemical Technology. Similarly, the Institute of Technical Physics and the Institute of Materials and Surface Engineering have combined to form the Institute of Physics and Materials Science. This consolidation has led to more focused research directions, increased collaboration, and improved efficiency in resource allocation. Research groups now operate with clearly defined scientific focuses, and professorial leadership ensures the production of high-quality research output. An administrative position, Vice-Dean for Innovation, was established to foster industrial collaboration and innovation processes.

As a result of the previous evaluation, NST introduced a tenure system. NST has a clear and well-defined academic career model and structure for a professor's research group. It also has a robust strategy to attract, support, and retain top scientific talent. Between 2019 and 2024, the unit has made significant steps ahead in expanding and strengthening its scientific personnel base, by integrating doctoral students into research activities, supporting early-career researchers and attracting and retaining international talent (the share of international academic staff at the unit increased from 8% in 2023 to 12% in 2024).

During the period 2019 to 2024, a substantial amount (€6.7m) was invested in the unit's infrastructure and institutional development, as well as €15m within the BBCE project. The unit's applications have also been successful in research infrastructure calls organised by RTU's Development Fund in 2025 and in previous years. Also, NST applied for €3.6m from the Structural Funds; the respective equipment will be purchased by 2026. Moreover, a lab space renovation plan worth €30m (2027-2031) is under preparation. Significant investments have been made in high-performance computing (HPC), chemistry laboratories, materials synthesis facilities, biotechnology, and environmental engineering research, ensuring that doctoral students have access to state-of-the-art resources, scientific equipment, and international-level research facilities.

In terms of infrastructure, the unit benefits from state-of-the-art research infrastructure, with laboratories equipped with unique experimental technologies comparable to those of leading European institutions, such as X-ray micro-computed tomograph- μ CT 50, Mass spectrometer (LC-MS), Confocal laser scanning microscope Zeiss LSM 900, High-Resolution Scanning Electron Microscope Verios 5 UC, Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES), Liquid chromatograph, and an NMR apparatus, among others. Students work in a multidisciplinary and multinational research environment and modernised and fully equipped laboratories with equipment for research and student training; doctoral students are integrated into national and international projects. The unit has developed a structured framework for research infrastructure management, ensuring efficient coordination, accessibility, and sustainability. Overall, the NST research environment and infrastructure are at an internationally competitive level, but require sustainable government support for upgrading and strengthening.

RTU has implemented an open data approach, in line with the FAIR principles. Aligning its research practices with transparency, collaboration, and accessibility also supports the implementation of the Latvian Open Science Strategy 2021-2027. NST has a clear research dissemination plan to guide activities and support personnel, and incorporates these principles into its research processes through Open Access, encouraging researchers to publish in open-access journals, making their work freely available to a global audience. During the evaluation period (2019 to 2024), near 65% of all the publications are available in open access, and there is room for improvement. This places NST above the average of European leaders.

Development potential

Score 4: very good

The unit has a reasonably clear vision for the future and well-defined plans to initiate new research directions (e.g., carbon farming, bioeconomy, renewable energy integration, defence). Strengths, weaknesses, opportunities, and threats are realistically assessed. The size of the unit is sufficient, but its ability to attract high-level doctoral students and scientists from abroad is moderate, although the numbers are increasing, with 11% of PhD students and 12% of researchers having an international background.

There are currently 100 doctoral students actively participating in research projects at the unit. The unit has consistently demonstrated a strong capacity to attract competitive research funding. The ratio of non-state to state funding is high. Involvement in international collaboration projects and networks is at a very good level and evolving. The fact that a good portion of international funding comes from EU FP projects is a positive sign of quality. And the Expert Group commends the efforts to focus on excellence-focused funding opportunities on the European level, such as ERC grants or ERA Chairs. Furthermore, the research conducted at the unit has a good component relevant to national needs in the fields of biomedicine, smart materials, energy systems, bioeconomy, and ICT.

Overall, the unit is able to establish itself as a recognised and respected player in the international scientific community within the scientific discipline of natural sciences. NST has a very good ability to advance in fundamental and applied research, attract talent, strengthen doctoral education, and foster knowledge transfer and industry collaboration. To achieve these objectives, NST has defined strategic, long-term research goals with realistic, planned key performance indicators (KPIs). It is expected that over the next 5-10 years, NST will achieve an excellent level of scientific quality and influence and will become a highly regarded partner in international collaboration projects and networks.

Potential to offer doctoral studies

NST offers three comprehensive PhD programs (Environmental Engineering, Particle Physics and Accelerator Technologies (PPAT, in collaboration with CERN) and Chemistry, Materials Science and Engineering) in key disciplines, providing doctoral students with research funding, guidance, and opportunities for academic and industrial collaboration in Latvia or abroad. Hence, the unit has a good potential to strengthen its programmes in this direction. The unit ensures access to state-of-the-art laboratories, scientific equipment, and international-level research facilities, enabling hands-on experience with innovative technologies. Over the assessment period, 95 doctoral dissertations were defended.

The unit is engaged in an annual assessment process to maintain the quality and relevance of its doctoral programmes. This involves gathering feedback and updating research areas based on emerging scientific and technological trends (e.g., by uniting the three doctoral programmes "Chemistry," "Chemical Technology," and "Material Science" into one modern, research-based programme of "Chemistry, Materials Science, and Technology"). Such measures ensure that doctoral studies remain attractive to students and competitive in the international research landscape while mitigating risks associated with programme adequacy and alignment of research direction. NST is focused on renewing human resources, enhancing infrastructure, and building capacity that ensures the sustainability of doctoral programs and supports early-career researchers.

Doctoral training is strongly integrated with international research collaborations such as MSCA, CERN, and Aalto University, providing PhD candidates with unique opportunities for summer/winter schools, training, research mobility, and hands-on research in high-impact collaborations. NST's approach emphasises industrial partnerships (industrial doctorate),

ensuring that graduates gain practical experience and career-oriented skills beyond academic research.

Alignment with the Smart Specialisation Strategy

NST plays a significant role in Latvia's Research and Innovation Strategy for Smart Specialisation (RIS3) by aligning its research and innovation activities with the RIS3 areas, achieving strong alignment and research outputs in four areas: photonics and smart materials; biomedicine, medical technologies, and pharmacy; smart energy and mobility; and information and communication technologies.

In the area of photonics and smart materials, it develops advanced functional and construction materials addressing sustainability, energy efficiency, and industrial needs. In the area of biomedicine, medical technologies, and pharmacy, NST advances healthcare through biomaterials, medicinal chemistry, particle therapy technologies, and pharmaceutical development. In the area of smart energy and mobility, the faculty supports the transition to a low-carbon economy through renewable energy systems, energy-efficient technologies, and sustainable mobility solutions. In the area of information and communication technologies, NST contributes by developing data analytics, detector technologies, and cybersecurity materials. It also corresponds with RTU's overarching strategic vision, ensuring integration with university-wide research initiatives and innovation ecosystems.

Conformity with state scientific and technology development

NST complies with both actions of the Guidelines for Science, Technology Development, and Innovation 2021-2027: 1) Research excellence and international cooperation development by offering high-quality academic career development opportunities that are competitive on an international scale; 2) Increase innovation capacity and social and economic value of knowledge and research by promoting innovation by developing high-value-added products, such as fish feed from non-food resources and alternative protein sources. It also pioneers technological advancements, including a novel flue gas purification device.

NST follows the Education Development Guidelines for 2021–2027 by offering secondary education in advanced physics and chemistry, vocational training for environmental technicians, and lifelong learning opportunities.

The National Industrial Policy Guidelines for 2021-2027 aim to enhance human capital and promote innovation. In this direction, NST trains specialists in STEM fields through industry-driven education and doctoral programs. By partnering with start-ups, SMEs, and multinational companies, the unit supports technology transfer, export growth, and access to EU funding and national innovation grants for R&D, ultimately strengthening Latvia's industrial competitiveness and economic growth.

Recommendations

The Expert Group has the following recommendations for the unit:

- Despite efforts already made by NST to decrease the proportion of doctoral graduates that exceed the normative time to degree completion, further improvements should be made. These can take advantage of the new RTU Doctoral School. Several measures may be implemented to support this objective, including the reduction of administrative bureaucracy and the provision of full-time positions for doctoral students, thereby facilitating more efficient progress toward degree completion.
- The unit has increased the number of high-quality publications during the last evaluation period. However, there remains scope to further enhance this output in order to approach the levels observed in European countries with a higher share (e.g., the share of Q1

publications is 80% in the Netherlands or 69% in Denmark), thereby enhancing the reputation and international visibility.

- NST should consider prioritising an increase in the number of international doctoral candidates even further by increasing involvement in joint doctorates with international universities and participating actively in doctoral networks, such as Marie Skłodowska-Curie Actions, to attract high-quality students.
- NST demonstrates a good collaboration with industry during the evaluation period, there is scope to further enhance impact by pursuing more strategic, long-term partnerships and collaborations with a wider range of industrial stakeholders.

E_10 Latvian Maritime Academy of Riga Technical University

2.2.19 The unit

The Latvian Maritime Academy of Riga Technical University (RTU LMA) is a higher education institution dedicated to training maritime professionals. Since its integration into Riga Technical University in 2022, RTU LMA has combined traditional maritime education with modern research and innovation. The mission of RTU LMA is to serve as a leading centre for maritime education, applied research, and innovation in the Baltic region. Located in Riga, RTU LMA is the only provider of higher maritime education in Latvia, offering accredited programmes and lifelong learning courses to support the maritime sector's workforce needs. RTU LMA organises its research around several key areas, including maritime digitalisation and cybersecurity, sustainable shipping, marine environmental protection, hydrodynamics and ship performance, and maritime logistics and efficiency. The unit emphasises interdisciplinary research, integrating engineering, environmental sciences, and digital technologies to advance sustainable maritime operations. Collaboration with shipping companies and technology developers enhances knowledge transfer and innovation.

2.2.20 Expert Group evaluation

Overall assessment

LMA joined RTU in 2022, after being awarded an overall score of '1' at the previous international evaluation. Since then, the number of research-active staff has reduced from 24.8 in 2022 to 6.7 FTE in 2024. This has impacted the overall research output, giving LMA a compound annual growth rate of -36% according to bibliometric data – one of the lowest scores of all units assessed by the Expert Group. The overall number of published papers reduced from 70 to 50 (with 31 in international, peer-reviewed journals). However, the international visibility of the unit has improved due to international collaborations with Italy, India, Sweden, Finland, Denmark, Estonia, Lithuania, and Ukraine.

Innovation can be seen as a theme running through research carried out at LMA, and the papers submitted for assessment, in areas of green technology, biodegradable polymers, re-purposing spent coffee waste, corrosion protection of magnesium alloys, cadmium recovery, and recycled rubber are of good quality. However, the papers carry multiple authors, which reduces credit given to individual contributors. Despite being involved in very important and forward-looking research, the research cluster of the LMA suffers from the problem of scale; it is clear that out of 96 total staff (with a 50/50 gender split), having 6.7 FTE research staff is insufficient to make an impact. The number of FTE research staff is minute, and decreasing, compared to the total number of staff; so LMA's role is mainly teaching. Staff who publish research papers are working part-time or have a large part of their time taken up by teaching. LMA will make no impact in research globally without a serious increase in research staff numbers. The few staff members who do the research produce quality work, and this should be developed further. This present situation, however, is not conducive to creating successful research groups.

LMA's social impact is mainly due to its educational activities; there is no evidence of popularisation of its research through public engagements, workshops, or advertisements. Scientific impact can be increased through membership on editorial boards of journals and editorships. The merger with RTU offers a unique opportunity for both institutions to consolidate their research, make good use of their combined resources and continue to innovate using increased human potential, and with a clearer and narrower focus on areas that are likely to bring scientific, social and economic benefits.

Progress on the joint doctoral training is not reported, with the LMA stating that this is now managed by RTU. The unit needs to increase its PhD and Postdoctoral student numbers and be responsible for the running of its doctoral studies. LMA needs to become even more active in the international arena, aiming at leadership rather than partnership in the projects. Given the current geopolitical situation, base funding for research is unlikely to increase, so a greater effort is required to secure competitive funding.

Quality of Research

Research at LMA focuses on supporting the 'circular economy' through the re-use/ re-purposing of old materials, reduction of hazardous waste, and maritime protection. Sample research papers submitted for assessment are of good quality, but they have numerous authors. Looking into the future, the Expert Group urges caution over publishing in predatory journals with a questionable reputation. MDPI publisher is gaining this kind of reputation, and although papers published there are not necessarily of poor quality, the reputation of the publisher does not give them a good first impression. The Expert Group recommends a check of lists, such as the Norwegian, Danish, or Finnish rankings, before deciding on where the paper should be published.

LMA's focus on innovation is clearly visible in the published works: durability of biodegradable polymer nanocomposites, use of spent coffee beans in the production of sustainable poly-bio-composites, maritime protection, corrosion protection of metals, recovery of cadmium from batteries, and utilisation of recycled rubber in next-generation composites. These topics reflect excellent awareness of issues related to climate change and depletion of our natural resources. Innovation is also present in the development of ballast water and greywater treatment, incorporating green technologies, and the floating vehicle disinfection device, resulting in two Latvian patents. Additionally, activities, such as the creation of sublimation technology for fish processing, oil spill detection, and ship structural safety, are examples of good responses to environmental and societal needs.

The LMA strategy is built around strengthening its expertise in maritime science and aligning with national and international priorities. Its objectives include increasing publications in high-impact journals, expanding participation in EU Horizon grants and other global projects, boosting international research funding to €800k by 2027, and developing the Maritime Innovation Centre. The quoted increase in research funding is relatively modest.

The overall research output is modest; the total number of publications over the assessment period is just over one for each FTE research staff per annum. LMA no longer reports PhD student numbers as they are now part of the RTU doctoral programme in Maritime Transport.

LMA has strengthened its research capacity through European collaborations in maritime digitalisation, sustainability, and law, partnering with institutions from Romania, the Netherlands, Spain, Croatia, Lithuania, and Finland in projects like DERIN, MareLaw, and OILSPILL. However, the total research income and income per research-active member of staff are still modest. LMA research crosses a number of disciplines, from autonomous vessels, smart port technologies and cybersecurity solutions that combine engineering and IT, to the development of eco-efficient ship systems, alternative energy sources, studies on ballast water treatment, waste management, and oil spill response.

Impact on scientific discipline

LMA self-assessment report states that over 50 scientific publications (2019–2024), have been produced, including 31 in international peer-reviewed journals. Of the 15 publications listed in the self-assessment report, 30% were conference or national journal papers. Five key papers listed in the self-assessment document have been submitted for assessment, which are indexed in Web of Science and Scopus.

Overall, LMA's impact lies in maritime civil engineering focused on: ship hydrodynamics, port infrastructure, ballast water treatments, and sustainable vessel design. This specialisation fills a knowledge gap that exists in the Baltic region and beyond. However, the results of these projects have not necessarily translated into publications. It is good to see LMA experts involved in shaping national maritime policy, often in collaboration with the Ministry of Transport and Maritime Administration in Latvia. LMA can improve its scientific impact further by increasing its membership on the editorial boards of journals and editorships.

Economic impact

LMA has increased its participation in several EU-funded projects, contributing to advancements in maritime sustainability, digitalisation, and safety. Key projects included: (i) ERAF (Postdoc) on green technology, developing innovative ballast water and greywater treatment to enhance eco-efficiency and sustainability in the Baltic Sea region, as well as establishing a new laboratory for research, (ii) ERAF (Postdoc) on environmental impact assessment of bio-polymer composites for 3D Printing and application in the maritime Industry of the Baltic Sea Region-project that strengthened collaboration with Italy, (iii) INTERREG Baltic Sea Region on oil spill response involving collaboration with 13 partners from Finland, Sweden, Denmark, Lithuania, Estonia, and Latvia, (iv) EU RRF Consolidation Projects focusing on maritime sustainability, digitalisation, and safety, (v) DERIN focusing on maritime digitalisation and sustainability, with Institutions from Romania, the Netherlands, Spain, Croatia, Lithuania, and Finland, and (vi) MareLaw on maritime law and sustainability. These projects address global maritime challenges and strengthen international collaboration.

LMA produced two patents in Ballast Water Treatment Systems: (i) "Ballast water disinfection apparatus" and (ii) "Floating vehicle water disinfection device", showcasing the development of eco-efficient solutions for maritime pollution control. It also has a patent in Sublimation Technology for Fish Processing: "Chamber of Lysophilization Apparatus Equipped with Physical Screens" to support innovative food preservation methods. Economic impact can be further developed by the establishment of spin-off companies.

LMA has partnerships with shipping companies, implementing the results of their research into onboard training and ship systems optimisation. Projects such as "Green Technology Solutions for Increasing Ship's Eco-Efficiency", and "Environmental Impact Assessment of Bio-Polymer Composites" have produced prototypes and methodologies that can be adopted by maritime industries.

Social impact

LMA has played a unique role in Latvia's maritime education tradition for over 230 years. It is the only provider of maritime education in Latvia, LMA supports lifelong learning through certified seafarer training programmes and awards over 900 certificates annually. Its Latvian and English programmes ensure access for local and international students. LMA fosters diversity and inclusion through growing female enrolment (8–10%), especially in navigation programmes. LMA graduates also contribute to civil society and work onshore in NGOs, professional associations, and national maritime organisations, reinforcing civic capacity and expertise. All of these activities relate to maritime education and lifelong learning. There is no evidence provided of research impact on society, either through public engagement programmes or doctoral training.

Research environment and infrastructure

Integration with Riga Technical University provides new opportunities for both LMA and RTU. Discussions with LMA's staff indicated that the gradual reduction in research-active staff numbers over the last three years, from 24.8 FTE in 2022, down to 6.7 FTE in 2023, is going to be reversed. Research infrastructure includes advanced navigation simulators, full-mission bridge simulators, engine room simulators, GMDSS, and ECDIS laboratories, mechanical workshops for ship systems research, a water research laboratory, and a materials science laboratory. Computing resources are provided by high-performance computing with a computational capacity of 0.5 PetaFLOP/s, 1,500 CPUs, and 28 GPUs, supporting research in machine learning, simulations, and data analysis. The UseScience platform is available for efficient data storage, management, and access. Engineers, IT specialists, and laboratory technicians are responsible for certain laboratories to ensure the optimal functioning of research infrastructure.

Administrative support includes services, such as grant writing, project management, and researcher training. Strategic planning, resource allocation, and user feedback mechanisms ensure continuous improvement. Annual quality reviews monitor the effectiveness of laboratory equipment, simulators, and digital tools.

Development potential

As part of RTU, the development potential of LMA is good, provided the number of research-active staff increases to a level that can make a real scientific impact, in terms of an increased number of publications in quality journals, memberships of editorial boards of journals, increased level of research funding comparable to that of international research institutions. It gives LMA a unique opportunity to increase activities in combined research groups, use RTU's facilities, apply for research funding, and propose joint PhD programmes. LMA's international visibility will depend on a critical mass of research-active staff and the level of funding. LMA is positioning itself as a key player in translating research into marketable solutions and supporting innovation in the maritime sector. It intends to become a leading centre for maritime innovation and sustainability in the Baltic region, focusing on high-impact, interdisciplinary research in areas such as energy-efficient ship systems, green corridors (stripped of connected natural or planted land such as parks, riverbanks, or verges), digital navigation, and autonomous technologies.

In the self-assessment report, there is no mention of a future increase in the number of research-active staff, but such plans have been confirmed in the direct discussion with the Expert Group. The number of FTE of research-active staff is low (e.g., 34 academics working only part-time on research). LMA will benefit from the economies of scale, as some of their research areas, such as the development of biopolymers for 3D printing, or autonomous technology, for example, are also subjects researched at RTU.

Potential to offer doctoral studies

LMA's former independent doctoral programme, "Maritime Transport," was integrated into RTU's "Transport" doctoral programme in 2022 and includes two specialisations: (i) Maritime Engineering Systems and Technical Operation focused on ship systems and technical operations, and (ii) Smart Port Technologies concentrated on digitalisation and automation in port management. The PhD doctoral training programme has commenced, but LMA is not in charge of its own programme. Funds have been allocated to support LMA academic staff in pursuing doctoral studies through the initiative "To strengthen the academic staff of the higher education institution in the areas of strategic specialisation". LMA has access to RTU's research infrastructure, including laboratories and interdisciplinary collaborations, which strengthens its ability to support doctoral-level research.

Alignment with the Smart Specialisation Strategy

LMA, as part of RTU, aligns its research and activities with Latvia's Smart Specialisation Strategy (RIS3) in areas of sustainable development, digitalisation, and innovation in the maritime sector. LMA's research and innovation efforts directly support the following RIS3 priorities: (i) development of eco-efficient ship systems, alternative energy sources, and solutions to reduce carbon emissions, (ii) ballast water treatment, waste management, and oil spill response to protect marine ecosystems. Projects, such as the development of ballast water filtration and renewable energy integration in propulsion systems, contribute to Latvia's climate neutrality goal and the EU Green Deal. Research into autonomous vessels, smart port technologies, and AI-driven shipping processes, optimisation of ship design and propulsion, and application of automation and AI in cargo handling and port management align with Smart Transport and Logistics. Development of cybersecurity solutions for maritime operations, and integration of online learning resources and analytics tools to modernise maritime education and training, align with digital growth.

Conformity with state scientific and technology development

LMA's research supports Latvia's National Development Plan and Transport Development Guidelines in areas such as sustainable energy, smart transport, and digitalisation. The Academy's focus on decarbonisation, digital transformation, and maritime safety aligns with the EU Green Deal and the IMO Strategy regarding the reduction of GHG Emissions from Ships. LMA's research outputs and industrial projects contribute to Latvia's scientific and technological development through maritime digitalisation, sustainable shipping, marine environmental protection, and water treatment. Participation in EU-funded projects and partnerships with institutions from Finland, Sweden, and Lithuania enhances Latvia's global scientific presence. LMA's future goals are to further reinforce its conformity with state scientific and technology development policies by obtaining €800k in international competitive research funding, increasing involvement in interdisciplinary research groups and international collaborations, and registering patents in green shipping and maritime cybersecurity.

While the research directions of the LMA are aligned with the national policy goals, it is too early to judge the degree of their achievement, as the unit is still largely a unique educational establishment, with a very small cluster of research-active staff. Collaboration with industry has been mainly limited to training and solving specific maritime problems, with no engagement in fundamental research.

Recommendations

LMA's research is of good quality, but it suffers from a problem of scale; it has a very small cluster of research-active staff (6.7 out of 34 FTE academic staff). Consequently, its overall research output is small and diverse, reducing impact on the relevant fields of science.

The Expert Group recommends:

- Bearing in mind the quality of LMA's research, the number of research-active staff needs to increase significantly.
- Efficient integration of research topics studied at the LMA and RTU faculties is needed. The Expert Group identified an overlap in the following areas: bio-composites, autonomous vehicles, cybersecurity, and novel materials.
- While developing its research potential, LMA needs to make use of RTU's platform for the PhD programme, as well as RTU's research infrastructure and brand, to ensure critical mass, visibility, and sustainability of its doctoral studies and research activities. This does mean

having some responsibility for such programmes and reporting on progress, rather than treating it as RTU's responsibility.

- LMA applies jointly with relevant RTU faculties for research funding, attracting more PhD and Postdoctoral students to increase overall research output.
- LMA has clearly defined responsibility for participating in relevant RTU's PhD programmes.
- To preserve their identity in research, LMA aims to lead and participate in international research projects and increase their presence at national and international conferences.
- LMA develops fundamental research alongside industry-focused research.
- Changes to the research activity of LMA, due to their amalgamation with RTU, should not be allowed to affect their position as a unique maritime educator.
- The Expert Group suggests that LMA be more selective about its publication venues.

E_11 Transport and Telecommunication Institute

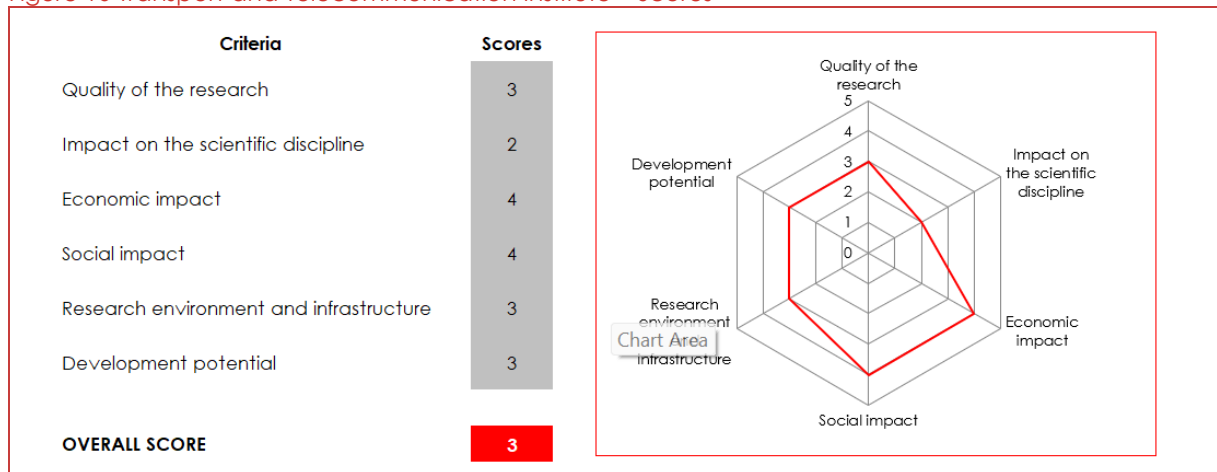
2.2.21 The unit

The Transport and Telecommunication Institute (TSI) is a university of applied sciences, which is recognised as an educational institution, scientific institution, and business unit. TSI's mission is to create and disseminate knowledge, making a positive impact on the community and the wider Baltic Sea region. TSI aims to be a leading private technical university in the Baltic Sea region, with a strong emphasis on international collaboration and societal impact. TSI organises its research around three main research directions: information and communication technologies (ICT), smart solutions in transport and logistics, and digital society and economy. The unit has established research clusters to support interdisciplinary research, integrate students, and strengthen industry collaboration. These clusters focus on modelling-based systems analysis and designs; data analytics and artificial intelligence; robotics, and additive technologies. TSI's research strategy prioritises applied research.

2.2.22 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 10 Transport and Telecommunication Institute – Scores



Overall score

Score 3: good level of research

The Transport and Telecommunication Institute (TSI) is a strong national player with emerging international visibility. Its research is multidisciplinary and application-oriented, with growing output in high-quality journals, including the Journal of Applied Science and Results in Engineering, and increasing international collaboration. The unit demonstrates solid performance in ICT, smart mobility, and logistics, and maintains effective partnerships with industry and public sector actors. However, the overall volume of research remains modest, and doctoral training is limited in scale, averaging just over one PhD per year. The infrastructure and strategic planning are well-developed, and TSI shows clear alignment with Latvia's RIS3 and national development priorities.

Further efforts are needed to reduce teaching loads, enhance publication quality, and attract more doctoral and postdoctoral researchers. The current focus on high TRL research could be balanced with more fundamental research to strengthen scientific depth. Taken together, these factors justify an overall score of '3', reflecting solid national relevance and promising development potential, but with room for improvement in international competitiveness and research capacity.

Quality of Research

Score 3: good

TSI conducts research in the areas of Information and Communication Technologies (ICT), smart solutions for transport and logistics, and the digital society and economy. Its niche expertise lies in intelligent transport systems, telematics, and logistics and transport modelling. The unit's research is primarily multidisciplinary and application-oriented, with strong links between engineering, data science, and real-world industry needs.

TSI publish their findings in international journals, including *Results in Engineering* and *Future Internet*, and conference proceedings. The proportion of papers appearing in high-quality journals (Q1 and Q2) is growing, currently representing around 50% of total output. Approximately 40% of publications involve international collaboration. While the absolute number of publications and citations indexed in Scopus and Web of Science is average, these figures are strong when normalised per researcher.

The unit provides satisfactory training for doctoral students; however, the number of PhD candidates remains low. The international profile of the researchers, reflected in invited lectures, editorial board memberships, and awards, is also around the international average: 16 were invited for presentations at scientific conferences and have memberships in editorial boards of scientific journals and 15 received prize awards.

The unit maintains active collaborations with international partners and attracts a relatively large number of international students, approximately 2,000 from over 30 countries, accounting for 25% of its student body. Research funding comes from the European Union, national funding bodies (e.g., LIAA voucher programme), and research-to-business (R2B) activities.

Overall, TSI demonstrates solid research performance and clear development potential. Although the publication volume remains modest, recent efforts to prioritise Q1 journals show a commitment to improving research quality. However, this focus has occasionally resulted in submissions to journals with lower rankings, including some MDPI journals, which are often perceived as having a less robust reputation. In addition, publications in the institution's own journal may limit the potential for broader dissemination and impact. New initiatives, particularly within additive manufacturing, signal positive momentum and a strengthening research trajectory.

Impact on scientific discipline

Score 2: adequate

Overall, TSI stands as a national player with emerging international recognition and clear growth potential. TSI has a well-defined scientific profile, and it demonstrates solid national relevance and growing international visibility. TSI is actively involved in several interesting R2B activities, for instance, those related to welding (Dinex Latvia) and the Smart Helmet (3D Engineering Ltd). On the international stage, they also participate in a number of competitive Horizon projects, such as TraNsport, ePIcenter, and RESKILLING. Research collaboration at the national level is strong, and partnerships with foreign institutions (e.g., Delft, TalTech, Fraunhofer IFF, Deusto, and University of Žilina) have been steadily increasing. It is also noteworthy that TSI annually organises the RelStat conference, with 57 contributions in 2024 published by Springer.

The unit's research output is moderate overall. Only 4% of its publications appear in HCP10-ranked journals, indicating a moderate presence in high-quality international journals. A large majority of the listed most important publications are published in Q1 journals, but in journals that may be perceived as questionable. The number of publications shows only a weak improvement over the assessment period.

TSI researchers produce slightly more than one publication per person, which is considered low. Although five patents were granted during the evaluation period, the research output per senior researcher remains modest, and while TSI emphasises a strategic focus on Q1 and Q2 journals, a considerable proportion of papers appear in lower-ranked journals.

The production of doctoral dissertations, averaging about one per year, is very low, and reports stemming from collaborations with industry and broader society have declined notably in recent years (from 13 reports in 2020 to only 2 in 2024). TSI contributes meaningfully to societal impact through participation in national bodies and, in some cases, international organisations (e.g., LIKTA, LETERA, MASOC, Women in Transport, Informatics Europe, EIT Urban Mobility, ECTRI).

Economic impact

Score 4: very good

TSI maintains strong partnerships with both national and international universities, as well as with numerous industry partners. For example, in 2024, TSI worked with the University Gustave Eiffel to co-organise a session on “Revolutionising Higher Education and Research in Transportation: AI-enhanced Curriculum Design and Implementation” at the Transport Research Conference held in Dublin. Special emphasis is placed on fostering international collaboration, and the unit demonstrates active engagement through visits, joint projects, and close interaction with the private sector. While participation in committees and scientific advisory boards of non-academic organisations is around the average level, collaboration with industry is notably effective. Since the last evaluation, the number of industrial projects, as well as the acquired budget has increased.

TSI’s research in smart transport, logistics, ICT, and related fields generates a clear economic impact. Much of this work is conducted through small-scale projects and service-oriented collaborations that directly address industry needs. Graduates, particularly specialists in logistics and IT, are readily employed, reflecting the strong alignment between the unit’s educational programmes and labour market demands.

The unit’s principal economic impact also derives from its educational activities, which contribute to national capacity-building in key technological domains. In areas such as intelligent transport systems, data science, cybersecurity, aviation, logistics, and transport modelling, TSI plays a significant role in advancing applied knowledge with tangible socio-economic benefits. The iDEAHUB concept further strengthens the integration of research and industry, promoting innovation and technology transfer.

Through iDEAHUB, TSI students and researchers receive support in transferring ideas and research into industry and in launching start-ups. Although no formal spin-off initiatives have yet been established, early-stage efforts are underway. Four national patents have been registered, along with one European patent, though the overall number of international patents remains limited. Overall, TSI’s research and innovation activities demonstrate growing relevance and impact, supported by productive partnerships and a strong commitment to applied, industry-oriented development.

Social impact

Score 4: very good

TSI demonstrates a strong and growing social impact through its research, education, and outreach activities. Its work in intelligent transport systems, telematics, and logistics and transport modelling directly contributes to addressing societal challenges in mobility, safety,

and sustainability. The unit's interaction with the public sector and society at large supports evidence-based decision-making and practical implementation of technological solutions.

TSI also plays an important role in enhancing Latvia's international visibility. Around 25% of its students come from 30 different countries, creating a diverse academic environment that fosters cross-cultural exchange and strengthens the country's global academic presence. The many iDEAHUB projects further reinforce the unit's societal contribution by stimulating economic activity and developing solutions to practical problems at both municipal and individual levels.

Evidence of effective knowledge transfer is seen in joint publications with industry partners and active collaboration with non-academic stakeholders. Moreover, several TSI researchers participate in professional and policy-oriented organisations, providing expert input that supports the development of informed public policies. For example, TSI has contributed to the ITF Transport Research Committee and the Latvian Transport and Education Association.

Research environment and infrastructure

Score 3: good

Research activities at TSI are primarily conducted in 11 laboratories equipped with some high-quality instrumentation that is continuously being upgraded. In addition to its internal facilities, TSI has made a strategic decision to form partnerships that provide access to advanced research infrastructure without the administrative and maintenance responsibilities of ownership. This approach is positively acknowledged by the Expert Group.

The research environment is currently expanding across all staff academic categories. A central component of this ecosystem is iDEAHUB, which serves as a platform for innovation, collaboration, and external engagement, effectively connecting research with industry and entrepreneurial initiatives. The Research Administrative Department plays an essential role in maintaining and enhancing the unit's research capacity.

Human Resources supports both staff and students by offering training opportunities and promoting the development of research competencies. Although the proportion of students involved in research remains relatively low, TSI demonstrates a clear commitment to open access and transparency in the dissemination of research results.

Through its efforts to strengthen infrastructure, expand strategic partnerships, and invest in human capital, TSI is well-positioned for sustained research excellence and increased international competitiveness.

Development potential

Score 3: good

TSI demonstrates a positive trend in its overall development and staffing. In recent years, the unit has shown growth in headcount and a marked increase in international collaborations. This momentum provides a strong foundation for further strengthening its research profile and global engagement. TSI has a clear vision for the future, supported by realistic plans.

A key opportunity lies in increasing publication output in high-ranking international journals, such as those published by Elsevier, Springer, IEEE, or Wiley, which would enhance the unit's academic credibility and visibility. While much of TSI's research currently operates at higher TRL, there is significant potential to complement this with more fundamental research. This balance would further strengthen the scientific depth and international standing of the unit.

Although the unit remains relatively small and its capacity to attract high-level doctoral students and foreign researchers is limited, the quality of its work and partnerships compensates

for its size. The ratio of non-state to state funding is very good, with state funding (e.g., LIAA voucher programme) accounting for only about 13%, while the majority comes from EU framework programs and other international sources. The unit's participation in EU projects demonstrates its ability to compete at the international level. Research conducted at TSI remains closely aligned with national priorities, ensuring relevance and impact within Latvia's socio-economic context.

Looking ahead, TSI is well-positioned to expand its role within international research networks. With strengthened emphasis on excellence in publication and diversification of funding sources, the unit is likely to strengthen its reputation as a credible and trusted partner.

Potential to offer doctoral studies

TSI currently offers doctoral training and degrees in transport engineering (telematics and logistics), but the number of enrolled doctoral candidates has declined (from 7-9 in 2019/2020 to 4 in 2023/2024) during the evaluation period, averaging just over one PhD awarded per year. While the unit demonstrates solid potential to strengthen its doctoral programs, supported by the scale of research and quality of infrastructure, the current low enrolment levels pose a challenge to long-term sustainability. To ensure the viability and impact of the programme, TSI must prioritise increasing the number of doctoral candidates and actively promote its research environment to attract high-quality applicants.

Alignment with the Smart Specialisation Strategy

TSI demonstrates strong alignment with Latvia's Smart Specialisation Strategy (RIS3), particularly in the domains of ICT, Smart Energy, and Mobility. Through its educational programs and research clusters, such as Data Analytics & AI, Modelling-Based Systems, and Robotics & Additive Technologies, TSI actively contributes to RIS3 objectives, including digital transformation, smart mobility, and cross-sectoral innovation. The unit also expands into adjacent RIS3 areas like Biomedicine and Medical Technologies, further broadening its impact. TSI's applied research projects, EU collaborations, and industry partnerships reinforce its practical contribution to RIS3 goals. Moreover, the unit participates in national RIS3 management groups, underscoring its strategic role in shaping and implementing innovation policy.

In addition to its RIS3 alignment, TSI's research and education activities support Latvia's broader national development priorities, particularly those outlined in the National Development Plan under priority two: "Knowledge and Skills for Personal and National Growth." The unit contributes meaningfully to the strategic directions of "Science for the Development of Society, the Economy and Security" and "Quality, Accessible and Inclusive Education."

Conformity with state scientific and technology development

TSI aligns well with Latvia's strategic frameworks for science, innovation, and industrial development. Its research activities in ICT, smart mobility, and logistics support the transition to a knowledge-based economy and contribute to RIS3 priority areas. TSI fosters collaboration with industry and the public sector, engages in EU-funded projects, and promotes applied research with societal and economic relevance. The unit also supports open science principles and maintains a modern research infrastructure. While doctoral training and publication output remain modest, TSI shows clear potential to strengthen its international competitiveness and innovation capacity in line with national policy goals.

Recommendations

The Expert Group recommends the following:

- TSI should take strategic steps to strengthen its research environment and output. The teaching load of academic staff should be reduced to allow more time for research activities. Improving efficiency in organising and scheduling teaching is one way to achieve this reduction, ensuring that academic resources are used more effectively.
- The unit should also reconsider its involvement in maintaining journals with limited international visibility, as these offer little reward and do not contribute meaningfully to its international research reputation. Instead, TSI should develop a clear publication strategy focused on high-quality, peer-reviewed journals and avoid publishing in low-ranked journals.
- To build research capacity, the unit should implement a targeted strategy for recruiting both doctoral candidates and postdoctoral researchers. Furthermore, it is important to encourage early-career researchers to pursue postdoctoral experiences abroad before joining the unit, as international exposure can significantly enhance research quality and networks.
- The unit's research is currently concentrated at high Technology Readiness Levels. The Expert Group suggests combining this with more fundamental research, either internally or through collaboration with external partners, to generate greater scientific momentum and long-term impact.

E_12 Riga Aeronautical Institute

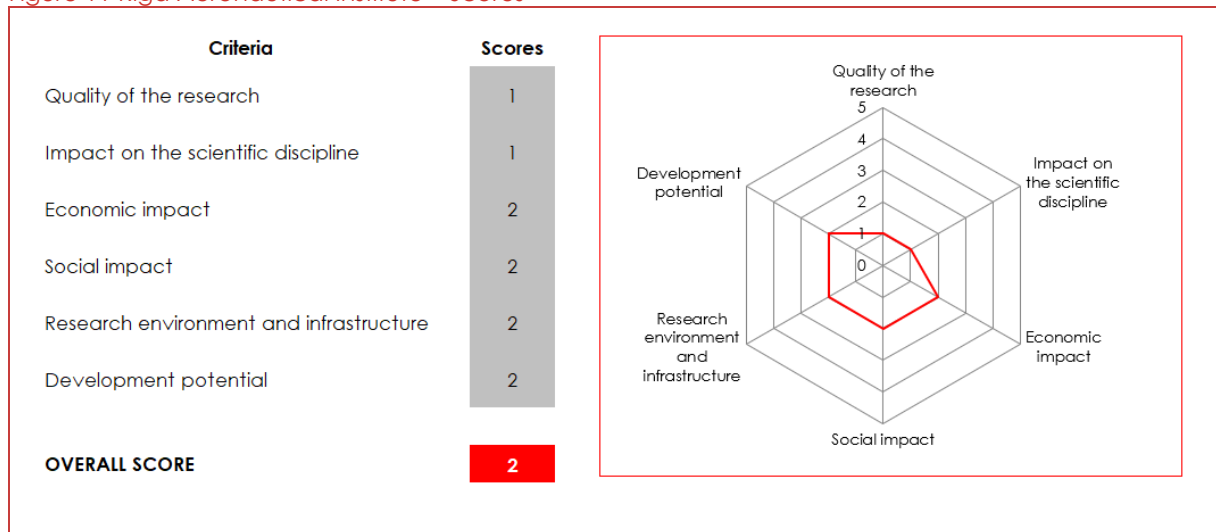
2.2.23 The unit

The Riga Aeronautical Institute (RAI) is a professional higher education institution in Latvia, focusing on applied research and training in aviation and transport systems. RAI operates as a joint-stock company, maintaining independence through private funding sources such as tuition fees and programme revenues. The unit's vision is to become a leading higher education institution in the Baltic region, contributing to local and international needs. Research at RAI is organised around several core areas, including innovative aviation systems, air traffic management, transport logistics, ICT mechatronics, and green transport technologies. The unit emphasises practical, application-oriented research that addresses specific problems in transport and engineering. RAI fosters interdisciplinary integration, combining fields such as engineering, informatics, and environmental sciences to support comprehensive solutions in aviation and transport. The research activities are closely integrated with academic programs, ensuring that students are trained with up-to-date knowledge and that research results are applicable in professional fields, particularly in aviation and transport sectors.

2.2.24 Expert Group evaluation

The figure below presents the scores assigned by the Expert Group to the unit.

Figure 11 Riga Aeronautical Institute – Scores



Overall score

Score 2: adequate level of research

RAI is a private higher education institution primarily focused on preparing qualified specialists for the labour market. The unit is academically very small, which makes it subcritical and therefore limits its ability to conduct advanced research across all the areas it aspires to address. RAI's overall research output is limited and diversified, and the unit does not yet provide formal training to doctoral students.

The publishing strategy and scientific impact of the institution have a limited impact, and the unit is not recognisable internationally in terms of publishing and the research output it produces. This is evidenced, for instance, by a Field-weighted Citation Index of 0.75 that remains below the global average of 1, or the average number of citations for the years 2019-2023 of 0.31.

Also, the economic impact of research at RAI remains limited. The unit produces a low volume of research, with no spin-offs, patents, or commercially viable intellectual property, and

publications have modest visibility and impact. While some local collaborations may generate small regional benefits, these effects are not substantial.

Overall, research of the institution is of moderate importance for society, in terms of research output, and given the unit's small staff and strong focus on teaching, the potential to increase the direct societal impact of research is low. However, by participating in expert groups (e.g., International Civil Aviation Organisation), RAI contributes to societal development at a broader level. The infrastructure is rather limited in space laboratories, with equipment mostly focused on teaching.

The institution is still only in the process of creating an internationally comparable research environment in the discipline of aviation and aeronautics. RAI has a reasonably clear vision for the future and plans to initiate new research directions (e.g., in Unmanned Aerial Systems (UAS) intelligent maintenance, aviation electronics, logistics, and ICT). The unit's collaboration with external industry partners (e.g. AirBaltic, Kreiss, EASA) provides a promising platform for further development. With a more systematic approach to innovation and commercialisation, these collaborations could be leveraged to generate spin-off companies and patents. While such outcomes are not yet in place, the conditions for developing them do exist and should be pursued as part of RAI's long-term strategy.

Quality of Research

Score 1: poor

RAI is a professional higher education institution, which is mainly focused on preparing qualified specialists for the labour market. The unit focuses on applied research that usually deals with the solution of a specific, practical problem, mainly in the fields of transport, aviation, mechatronics/robotics/Unmanned Aerial Vehicles (UAV), and composites. The Expert Group finds an imbalance between fundamental and applied research. It acknowledges that RAI's mission is to address the demands of the Latvian economy by integration of academic knowledge and applied research; the focus on applied research is in line with the unit's mission. However, a thriving research environment depends highly on the synergy between fundamental and basic research, where fundamentally new approaches can stimulate innovation.

Moreover, collaboration across disciplines is weak. The unit is academically very small, which makes it subcritical and therefore limits its ability to conduct advanced research across all the areas and fields of research it aspires to address. Although research staff accounts for 40% of RAI's academic personnel, the total number of FTE remains low (e.g., in 2024 the total number of academic research personnel across all staff categories was 1,5 FTE). Given the very small size of the unit, the research should be more focused on fewer topics, such as transport logistics and management, air transport systems, and air traffic management.

Researchers of RAI have published the results of their research mainly in less reputable journals (e.g., Balkan Social Science Review, Romanian Journal of Applied Sciences and Technology, Composites Theory and Practices). Only a limited number of articles are published in indexed journals or in conference proceedings with Q1/Q2 ratings (e.g., World Congress of Computer Science, Management and Production Engineering Review). Even when adjusted for staff size (around 15 in the period 2019-2024), they are not of high academic standards. Publications are produced by a small fraction of the total body of researchers. The number of quality publications is noticeable. In 2019, one full-text publication was published in an indexed venue, eight were published in 2020, two in 2021 and one each in 2023 and 2024. In the list provided in the self-assessment report, the Expert Group does not see evidence for a strategy prioritising quality publications. In the assessment period, 13 articles were published in indexed journals and 50 in non-indexed venues. While non-indexed journals can also publish high-quality, peer-reviewed articles, the unit's current publication strategy does not effectively maximise the visibility of its research, as evidenced by the citation statistics.

According to data provided in the self-assessment report, the unit has not been able to attract competitive research funding over the past five years. However, 15 projects in the area of aviation safety, ICT, practice-oriented laboratories, innovative educational programmes, and entrepreneurship development have been funded by RAI directly. While the efforts to fund research projects in-house are commendable, the Expert Group identifies significant potential and a pressing need to acquire external research projects. Beyond financial support, third-party funding offers valuable opportunities to foster institutional growth, strengthen collaboration with both academic and non-academic partners, and serves as an external validation of the unit's research quality. The Expert Group sees considerable room to extend the administrative support for grant writing to support researchers.

The international profile of researchers, as evidenced, e.g., by invited lectures, editorial boards, awards, etc., is moderate. This is evidenced, for example, by the unit's international collaboration rate (ICR), which is on a moderate level (23.5%). There are some international researchers actively participating in the unit's research activities (e.g., from Qatar, Lithuania, or Poland), and the RAI's academic staff also participates in research activities abroad. But the Expert Group sees considerable potential to expand international activities.

Overall, the institution is a weak national player. And the Expert Group finds that the unit's research demonstrates too little novelty.

Impact on scientific discipline

Score 1: poor

The specific scientific discipline covered by RAI is focused on practical problems, with relevance to the labour market; hence, the Technology Readiness Level (TRL) of the research is high. However, the volume of research output is very low and diversified. The number of publications in high-quality international journals with high impact is very low, and also, the number of research outputs per researcher in Scopus/WoS is low. As per international indexes, the compound annual growth ratio (CAGR) is about -13%, the average of relative citations (ARC) is 0.31, the field-weighted citation index (FWCI) is 0.75, the percentage of highly cited papers 10% (HCP10) is 0%, and the share of publications in Q1 journals is also 0%. These numbers are very low.

Also, the research collaboration at the national level is moderate, but evolving. This collaboration involves bilateral cooperation (e.g., with Riga Technical University) without monetary value. Efforts with foreign collaborators have been moderate but are increasing. Examples of collaborative activities include bilateral cooperation with Kaunas University of Technology, the Civil Aviation Academy of Kazakhstan, the International School of Finance Technology and Science in Uzbekistan, the Qatar Aeronautical Institute, etc., all without monetary value.

Memberships in editorial boards of scientific journals are very limited (one researcher), and involvement in scientific committees and advisory boards is moderate (four researchers). The unit is the organiser of the biannual International Conference on Transport Education and Logistics, a few student events, and a couple of workshops within the framework of Erasmus+. Overall, the publishing strategy and scientific impact of the institution have a limited impact, and the unit is not recognisable internationally in terms of publishing and the research output it produces.

Economic impact

Score 2: adequate

Overall, the economic impact of research at the unit remains limited. RAI produces a low volume of research, with no spin-offs, patents, or commercially viable intellectual property.

RAI has been collaborating with enterprises (Kreiss, Vam-Trans, pilot academies, airports, etc.) both in Latvia and abroad on IT services, education, engineering, etc. However, due to trade secrets, the monetary value of these activities has not been disclosed. Internships, state examination commissions, curriculum development activities, and consultation with some enterprises and airports are reported. Where monetary information is provided, the figures of monetary value are low. The unit is also involved in the development of organisational management in the scope of different topics in the aviation and transport industries in Latvia, the UK, Sri Lanka, etc. Also, the unit has contributed to enterprise policy development planning. While some local collaborations may generate small regional benefits, these effects are not substantial.

Overall, the research contributes economically primarily through its integration into education and lifelong learning, rather than through direct innovation, commercialisation, or high-impact research outcomes. RAI has the potential to play a positive role in bridging academia and industry through collaborations with stakeholders in aviation and transportation, but this is not well-developed yet. The unit makes efforts to partner with companies and organisations to ensure its output aligns with current industry needs, primarily in the field of education. These partnerships involve consultations and practical training programs, providing students with hands-on experience, but limited research.

Social impact

Score 2: adequate

The social impact of the research in the RAI is low in terms of research, but higher in terms of education. A good example of positive social impact is the student scientific and technical conference, organised by RAI, and the initiative "Profession in the Field," targeting top-performing school children for advanced training in engineering and aviation. Science communication (workshops, TV, radio, etc.) is limited. The same applies to influence on policymaking, due to the limited involvement of researchers in policy/regulations-related committees. Examples of involvement in expert groups include the International Civil Aviation Organisation and the European Civil Aviation Conference. RAI contributes - but to a low degree - to national security and public health through its research in air traffic safety, cybersecurity, UAV, human factor studies, etc. For instance, RAI has contributed to the development of the Aviation Development Concept together with the Ministry of Transport, as well as to the preparation of professional standards together with the Ministry of Education and Science. Through the Latvian Aviation Association, the institute has been involved in drafting legislative amendments.

Overall, research of the institution is of limited importance for society, and given the unit's small staff and strong focus on teaching, the potential to increase the direct societal impact of research is low.

Research environment and infrastructure

Score 2: adequate

RAI's approach to the development of scientific personnel includes a limited number of international collaborations, support for returning alumni, interaction with industry, and some limited planning for future doctoral studies. However, so far, no doctoral students are enrolled, and there are limited efforts to attract international visiting researchers. However, the unit is working in the direction of introducing a doctoral programme in the future.

The organisation of the unit's management of research is still evolving. The staff is moderately gender balanced, and the unit's age structure is moderately balanced and sustainable. The unit's current management is satisfactory, but planning for expansion towards advanced equipment for research purposes is insufficient, as per international standards. The unit demonstrates moderate ability to ensure open access to research results.

As most research conducted at RAI does not require specialised equipment, the infrastructure is basic, mainly for teaching purposes, and not research-oriented. It comprises a library and laboratories with IT systems, simulation technologies, and electronics; however, the space is limited. For more specialised and in-depth research, for instance in fields like materials science or electrical engineering, RAI collaborates with partners, such as Kielce University of Technology, under contractual agreements.

Overall, the institution is still only in the process of creating an internationally comparable research environment in the discipline of aviation and aeronautics.

Development potential

Score 2: adequate

Overall, RAI has a reasonably clear vision for the future and plans to initiate new research directions in UAS, intelligent maintenance, aviation electronics, logistics, and ICT. A clearer strategic focus – rather than dispersing efforts across a wide range of fields – would increase the chances of achieving significant impact. Regarding education, the growing global demand for qualified professionals in the aviation and transport sectors presents an opportunity to expand RAI's educational outreach. Yet, how this will be achieved is not clear.

Strengths, weaknesses, opportunities, and threats are realistically assessed. The size of the research body is very small, and its ability to attract high-level scientists from abroad is limited. RAI does not receive any funding from the state budget or other governmental funding organisations; its research activities are financed mainly through tuition fees and revenue generated from various educational courses and programmes.

Research conducted at the Institute has a good component relevant to national needs, but it is very limited in size. Involvement in international collaboration projects and networks is evolving. The unit's collaboration with external industry partners (such as AirBaltic, Kreiss, EASA) provides a strong platform for further development. With a more systematic approach to innovation and commercialisation, these collaborations could be leveraged to generate spin-off companies and patents. While such outcomes are not yet in place, the conditions for developing them exist and should be pursued as part of RAI's long-term strategy.

Potential to offer doctoral studies

To conduct doctoral education, a critical mass of supervisors with sufficient research competence, an adequate number of doctoral candidates, as well as state-of-the-art infrastructure to support the students, is required. A doctoral programme should include doctoral-level courses, and candidates must be embedded in a vibrant research environment. At present, RAI is too small to provide this environment on its own. However, by collaborating with larger universities, RAI could still host doctoral candidates - for example, as external or industry-based PhD students. In this way, this small unit could engage in doctoral education without independently maintaining a full-scale research environment. The unit is actively exploring collaborations with larger universities to host doctoral candidates. Co-supervising PhD students can strengthen ties with top-level research, create opportunities for co-publications, and expand the unit's research staff capacity. Therefore, the unit could build on already existing efforts in the co-supervision of master's theses.

Alignment with the Smart Specialisation Strategy

RAI directly supports RIS3 via its research and innovation in smart mobility and ICT areas. The unit's applied research in aviation, transport logistics, AI, and green technologies aligns with RIS3 goals of fostering technological advancement and economic transformation. RAI's collaboration with industry and involvement in international projects, including ERASMUS+,

further promotes RIS3 objectives, especially in knowledge transfer and human capital development. By integrating students into research and emphasising interdisciplinary solutions, RAI does contribute to the implementation and advancement of RIS3 specialisation areas.

Conformity with state scientific and technology development

RAI aligns its activities well with Latvia's national priorities and policies in education, but to a limited degree in science and innovation. Human resources dedicated to research are scarce, and there is plenty of room for strengthening collaborations with the industry to develop solutions and boost their innovation capacity. Internationalisation is moderate and covers activities in the framework of the ERASMUS+ programmes and the exchange of expertise with institutions such as the Civil Aviation Academy of Kazakhstan, the Navoi Innovation University of Uzbekistan, and the J&C Aero in Lithuania.

Recommendations

- RAI needs to develop a clear strategy, focusing on a few areas only (such as transport logistics and management, air transport systems, and air traffic management), thus minimising diversity.
- The unit should shift – at least partly - their research from very high technology readiness levels (TRL) to lower TRL. Focusing only on high-TRL research with short-term returns may ultimately be detrimental for long-term planning. Balancing the applied researcher with fundamental research helps to create radical new ideas and applications, serving as the foundation for long-term innovation and scientific breakthroughs.
- The Expert Group suggests RAI to professionalise research management, e.g., by having dedicated personnel.
- RAI need to develop a publication strategy. The unit must carefully consider which journals they choose to publish in. Publications in high-quality journals reach a wider audience and thereby increase visibility, whereas journals such as the Balkan Social Science Review, Romanian Journal of Applied Science and Technology, Composites Theory and Practices, where RAI has published in recent years, are of very limited visibility.
- The Expert Group recommends that the unit increase research personnel and plan for the succession of older staff who might leave.
- At present, RAI is too small to provide an environment for doctoral studies on its own. However, by collaborating with larger universities, RAI could still host doctoral candidates, for example, as external or industry-based PhD students. In this way, this small unit could engage in doctoral education without independently maintaining a full-scale research environment.
- The Expert Group suggests that researchers at RAI should consider developing stronger ties with other research groups in Latvia and abroad, so that they can combine their experience in practical matters.

3 Summary of findings across the set of unit evaluations

The general level of quality of research

Overall, the Expert Group was pleased with the average research quality of the units. Three units, the Faculty of Computer Science, Information Technology and Energy (FCSITE), and the Faculty of Natural Sciences and Technology (NST), both within Riga Technical University, and the Institute of Electronics and Computer Science (EDI), have easily reached a very good level of research, being strong international players. Many other units have clearly improved their research output and quality within the assessment period. The best units demonstrate a high level of participation in international projects, including Horizon Europe. They also have good citation statistics with a number of publications creating international recognition and a high impact on their disciplines. Moreover, they create good/outstanding economic and social impacts and show advanced potential to offer doctoral studies. Across the units, the research environments are generally well managed according to international standards, and impressive research infrastructures are modern and constantly updated. The three top-ranked units have reached their current level with good strategic choices leading to progress stemming from a virtuous cycle and thus have excellent chances to become world-leading players in their fields of science. For many of those with lower scores, the Expert Group found significant scope for potential development with various merits, and thus, by further development, the possibility to increase their research quality and impact.

Key strengths

The Expert Group finds that the funding attraction, especially in the success of winning the highly valued Horizon projects, is relatively good within seven units (IMCS UL, EDI, CVS, FCME, FCSITE, NST, TSI), which can be appreciated, although coordination roles can be found only in a few cases.

One important strength of all units is their economic and social impact. There are plenty of activities with mostly regional companies supporting their development, many research findings are patented, and start-ups/spin-offs have been established, the latter one being not so common also outside Latvia. It is clear that the more advanced units have a network with international, larger companies, leading nonprofit research organisations focused on applied research like Fraunhofer (Institute of Electronics and Computer Science), and the intergovernmental research organisation CERN (NST). An example of a successful long-term collaboration with a large national company is the partnership between the Vidzeme University of Applied Sciences (VIA) and the Latvian SIA Latvijas Mobilais Telefons. Many units have also networking activities like COST Actions (NST, the Rezekne Academy of Riga Technical University (RTA), the Faculty of Civil and Mechanical Engineering (FCME)), and ERASMUS projects (RTA, The Riga Aeronautical Institute (RAI), The Latvia University of Life Sciences and Technologies (LBTU)).

There is a large variety of quality of the research environment and capabilities which available through research infrastructures. The highest-ranked units have very advanced management strategies to attract and support young and advanced talents with career planning, and they have established, e.g. a tenure track programme. It is clear that the top-ranked units have had better possibilities to develop their research infrastructures, but also some others have been able to create research infrastructures at a highly competitive level (LBTU, EDI) with careful planning, concentrating on their strengths.

A common strength is also that almost all units are committed to interdisciplinary and multidisciplinary research that has national and/or regional impact and is aligned with RIS3 and Latvia's state objectives for scientific, technological, educational, and innovative development in many senses.

Main weaknesses

The Expert Group finds the main weaknesses related to publications. Most of the units should enhance the quality of research to ensure that the findings meet the standards required for publications in high-impact international journals. Also, in some units, the number of active researchers tackling this challenge is relatively small, and only three units have the Field-weighted Citation Index (FWCI) over the global level. Also, an increased ambition to apply for funding under the Horizon Europe Framework would be extremely important for almost all units, and the ones that are already successful should be active within Pillar I, which includes ERC. The Expert Group identified a common challenge across all the units: attracting PhD students, young talents, and top-level scientists – and retaining them, except in units with advanced HR planning.

Conclusions

Despite significant variation across the units, it was impressive to witness their commitment to making the best use of their resources and, especially, the good or even outstanding development potential in many of them. The competitiveness of units can be improved by ensuring better salaries to attract talent, providing stable opportunities for students, and increasing international recognition.

Recommendations

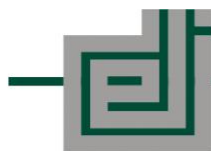
- The Expert Group has observed a trend among several units to prioritise publication in Q1/Q2-ranked journals. While this strategy is not inherently problematic, this quality measure is somewhat crude, and the Expert Group notes with concern that it has resulted in many publications being published in journals that are internationally perceived as having low scientific or even questionable quality or limited international impact and visibility. Thus, the units should target what is regarded by experts as the top journals or conference venues in their disciplines.
- During the site visits, the Expert Group found that the conditions for doctoral students varied considerably between units. In order to ensure the sustainability and success of doctoral education, it is essential that doctoral candidates are provided with stable and sufficient financial support throughout their studies. Without such support, there is a risk that students may be unable to complete their degrees, which could negatively affect both individual careers and institutional research capacity.
- The Expert Group also identified a notable lack of basic research activities across most units, with only a few exceptions. While applied research at TRL 6–9 is important for innovation and societal impact, the Expert Group emphasises that a healthy research ecosystem must also include space for curiosity-driven, fundamental research. Such research is critical for long-term scientific advancement and for academic excellence.
- Additionally, the Expert Group observed that some units are involved in the administration of academic journals that lack clear international reach or recognition. This may limit the visibility and credibility of the research published therein and could hinder international collaboration and dissemination.
- The Expert Group received consistent feedback from researchers regarding the administrative burden associated with national research funding applications. The Expert Group considers this an unfortunate and counterproductive situation that warrants attention, as it may undermine the efficiency and productivity of the national research system.
- A request that was addressed during visits was that it is important for Latvia to become a full member of the European Space Agency, and not just an associate member state. Achieving full membership would provide units with expanded opportunities to develop research in space-related fields, participate in a broader range of ESA projects, and strengthen their international collaborations and visibility in this strategically important area.
- Institutes with limited research capacity in terms of personnel should focus on fewer, but niche, topics, where they may have the potential to make an impact at an international

level. It would be important to concentrate on the unit's strengths and build on those with careful planning when making new research direction openings.

- Most units require a more advanced and transparent HR plan to support long-term organisational development. This enhancement should focus on improving processes, governance, and digital capabilities rather than expanding the HR organisation or increasing administrative headcount.
- The units could share best practices by organising seminars or workshops that include anonymised examples of successful project applications, sessions on proposal writing, and peer-review groups to evaluate drafts before submission. Additionally, it would be valuable to share timely updates on upcoming funding calls. The best practices on research infrastructures (e.g., safety training), PhD training (e.g., supervisors' seminars), and publishing results (e.g., a course on writing academic manuscripts for high-quality publications for PhD students) could also be useful.
- The Expert Group welcomed the ongoing institutional amalgamations in Latvia but warned that they risk over-concentrating resources in Riga, and therefore urged the Ministry and university leaders to develop explicit policies and clear plans to ensure that regional universities and campuses continue to play a strong role in local and regional social and economic development.

Appendix A Feedback on Expert Group assessment

Feedback from the Institute of Electronics and Computer Science



ELEKTRONIKAS UN DATORZINĀTŅU INSTITŪTS

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Uz _____ Nr. _____

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Feedback on the report for inclusion in the Appendix of the Expert Group report

On behalf of the institute, I would like to thank the members of the expert group for the evaluation report, recommendations, overall assessment and comments, which emphasize that we conduct high-quality applied research that is comparable to highly regarded international industrial research institutes, and that our impact on the scientific discipline is very high, as documented, for instance, by our participation in many Horizon projects and excellent citation statistics. However, we believe that we need to provide our own explanations for certain sub-criteria to avoid misinterpretations by external stakeholders without knowing the specific facts.

In the evaluation report, the quality of our research is scored as 3: “good”, which according to “*The methodology for International Evaluation of Scientific Institutions of Latvia*” means “*The unit is a strong national player with some international recognition. ... Internationally recognized publishers or journals could publish work of this level*”. Considering that in the previous evaluation period (2013-2018), the quality of our research was scored as 4: “very good” (“*strong international player*”), at first glance, it might seem that the quality of our research and international recognition have been declined. However, we can proudly say that, in our opinion, it has definitely improved, which is confirmed by key indicators in our self-assessment report, as well as by comments from the expert team. Specifically, the Institute's involvement in EU Horizon projects compared to the previous evaluation period has increased from 12 to 31 projects, which in terms of attracted funding is from 1.13 MEUR to 8.88 MEUR (about 8 times!), and in terms of attracted funding per FTE, the institute is a convincing leader among all scientific institutions in Latvia. During the reporting period, we expanded our participation in European Space Agency (ESA), ERA-NET, EIT and other international programs as well. International Projects represent the largest share in our R&D budget (41.3%).

We thank experts for acknowledging these achievements in their comments under the “*Impact on the scientific discipline*” criterion: “*Such a strong project presence naturally leads to significant international recognition and impact*”. This clearly addresses and dispels any possible doubts about our international recognition that may have arisen due to the score given in the “*Quality of research*” criterion. Similarly, the expert comment “*The high interest in the research outcome is also clear from the citation statistics, which are high in both the average number of citations and the number of articles published in the highest-cited journals*” confirms

**DOKUMENTS IR PARAKSTĪTS ELEKTRONISKI
AR DROŠU ELEKTRONISKO PARAKSTU UN SATUR LAIKA ZĪMOGU**

that, despite many articles being published in MDPI journals, our research is also published in internationally recognized Q1 and Q2 journals (increased compared to the previous evaluation period to ~71%, (Q1 ~44%)) and is receiving strong citation impact. Unfortunately, neither during the evaluation period nor in the evaluation methodology was any indication given that publishing in MDPI journals would negatively affect the “*Quality of Research*” score, irrespective of the quality of the publications or their citation impact.

We are proud that experts have indicated the quality of our research as “*very good research level*” in the comments in the “*Overall score*” section, as opposed to “*good*” in the criterion “*Quality of Research*”. Even more, experts recognize “*The unit conducts applied research of high quality, comparable to highly regarded international industrial research institutes*”, which, taking into account that “*Fundamental and applied research shall be evaluated as being of equal significance*” stated in “*The methodology for International Evaluation of Scientific Institutions of Latvia*”, actually ranks our institute among the best international research and technology organizations. Considering the experts' assessment of “*The unit's impact on the scientific discipline is very high*”, in our understanding, there cannot be a very high impact on the scientific discipline if the research itself is not at least “*very good*”!

Regarding the expert comments on “*Economic Impact*”, “*Social Impact*”, “*Research Environment and Infrastructure*” and “*Development Potential*”, although not all of them have been scored as 5 “*outstanding*”, we are proud that there is not a single negative comment in them. This helps confirm that our activities are developing in the right direction, as noted in the expert comment on the “*Development potential*” criterion that we have shown “*impressive growth during the evaluation period, the clear vision and leadership of the management, the unit's participation in competitive international projects, and the impressive ability to foster young talent and provide responsibility and support already early in their career.*” This gives us confidence to continue our activities in the same way!

Signature valid

Director

Modris Greitāns

Digitally signed by MODRIS GREITĀNS
Date: 2026.01.23 20:35:00 EET

Feedback received from Riga Aeronautical Institute

Dear Florentine Franz.

We got your message from 19.02.2026.

It is clear and understandable. While we recognize the effort and expertise invested in the Expert Group Evaluation of RAI,

we cannot fully agree with some of the conclusions presented.

For instance, despite an overall score of 2, the criteria Quality of Research and Impact on the Scientific Discipline were rated as 1.

Similarly, Social Impact and Development Potential could be evaluated more favorably,

We would also like to highlight RAI's full compliance with Alignment with the Smart Specialization Strategy

and Conformity with National Scientific and Technological Development Objectives,

which we believe should be taken into account as an additional positive factor in the assessment

We appreciate the recommendations provided for the further development and improvement of RAI's scientific activities

and are committed to implementing them to strengthen our research impact.

Sincerely,

Ar cieņu,

Vladimirs Reiskarts, Dr. sc. comp., Zinātņu prorektors,

Studiju virziena Elektronika direktors,

AS "Rīgas Aeronavigācijas Institūts"