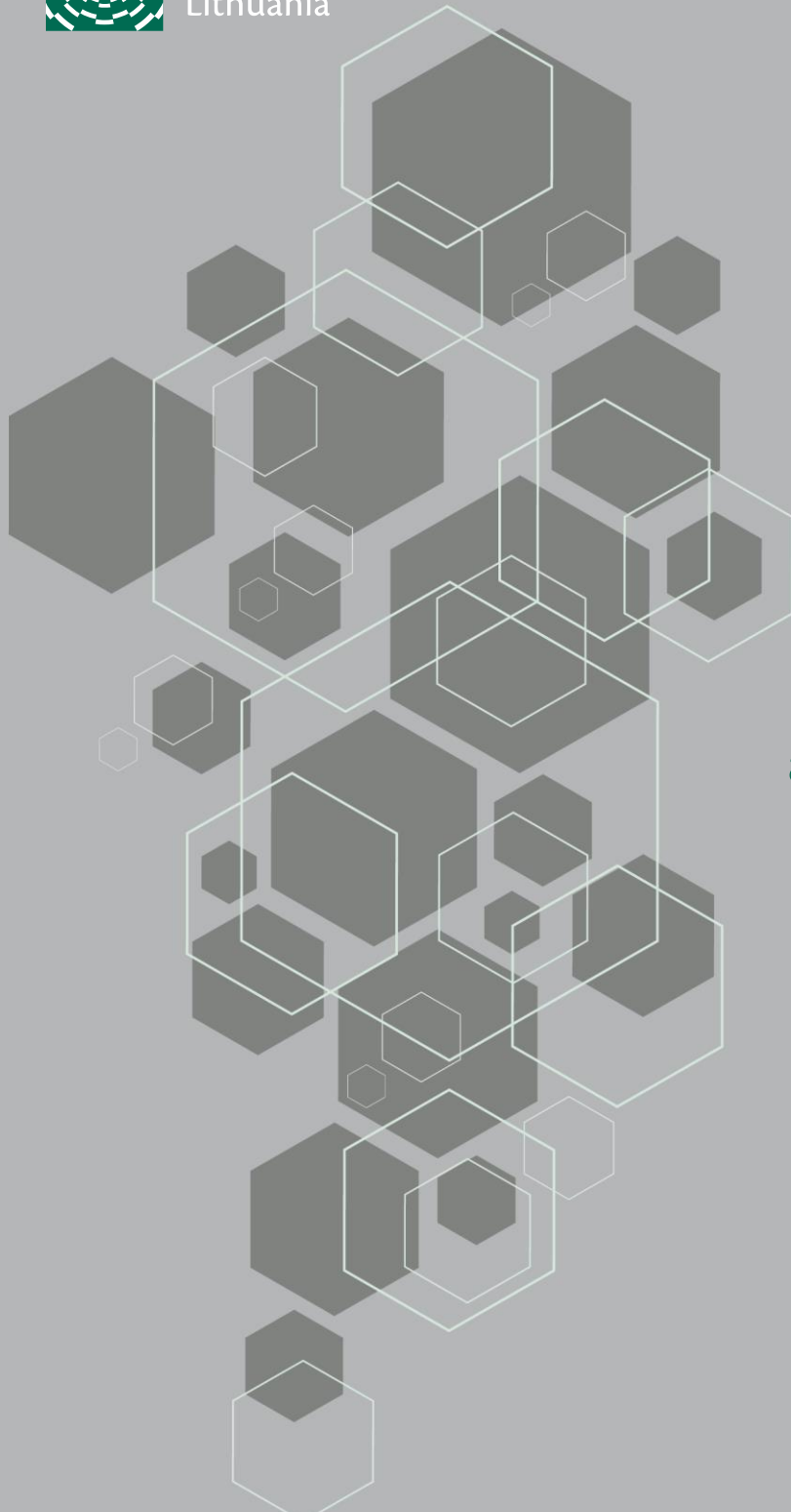




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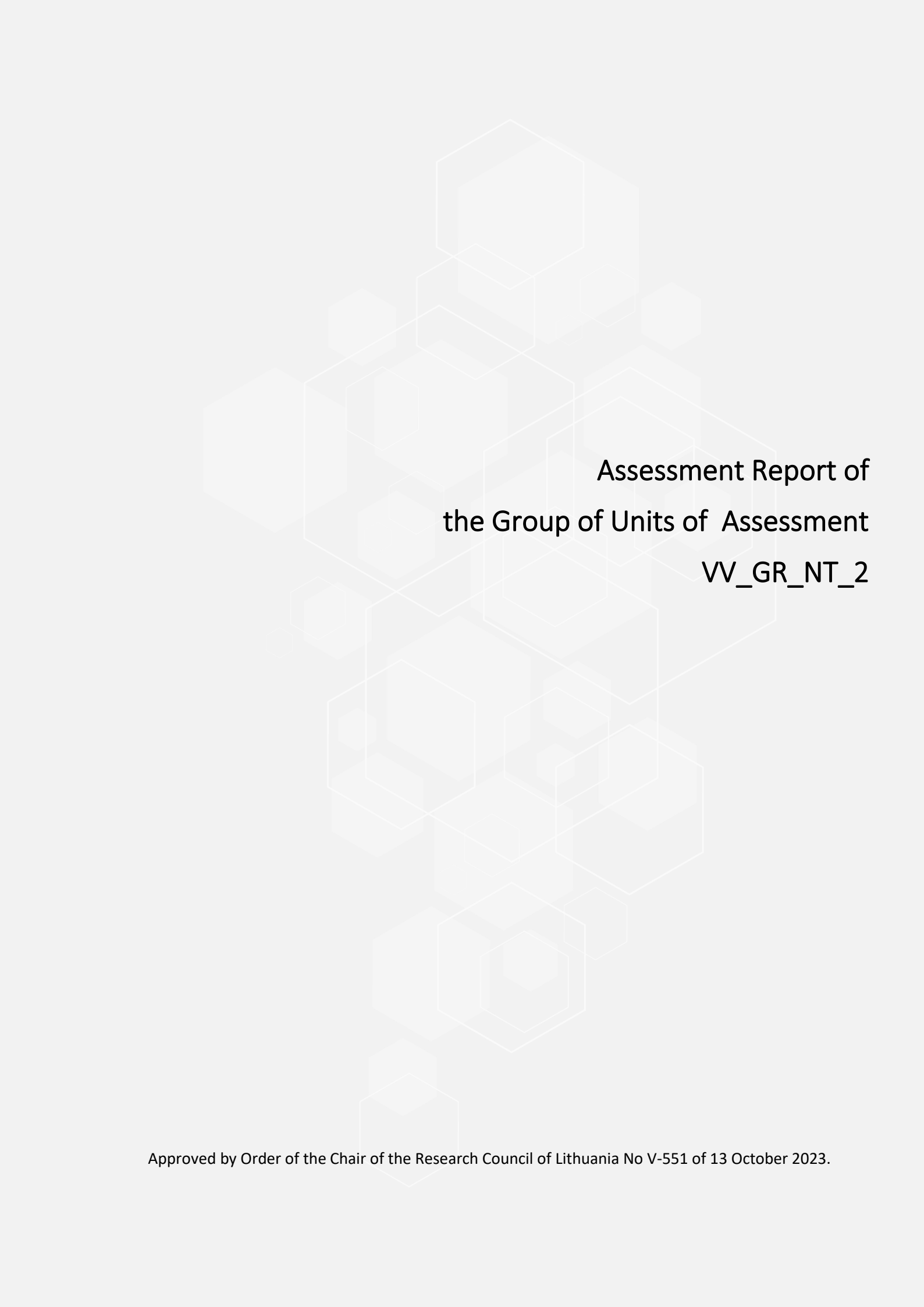
**Assessment Report of
Comparative Expert
Assessment of Research
and Development Activities
Carried out by Universities
and Research Institutes for
the Group of Units of
Assessment VV_GR_NT_2**

Vilnius 2023



2014-2020 Operational
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**Assessment Report of
the Group of Units of Assessment
VV_GR_NT_2**

Approved by Order of the Chair of the Research Council of Lithuania No V-551 of 13 October 2023.

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Terms & Abbreviations

CEA – Comparative Expert Assessment of research and development activities carried out by Lithuanian universities and research institutes

FTE – Full-Time Equivalent

Institutions – Lithuanian universities and research institutes

RCL – Research Council of Lithuania

R&D – Research and Development

UoA; Unit(s) – Unit(s) of Assessment

FTE¹ – the number of working hours worked during the year by a certain group of employees divided by a number of working hours in the 12 months of that year, as set by the Minister of Social Security and Labour (with a 5-working-day week). <.> The FTE unit – a person per year.

FTE(SD)¹ – the sum of the FTE of teaching staff members with a science degree divided by 3, and the FTE of research workers and other researchers with a scientific degree.

Research areas:

N – Natural Sciences; **T** – Technology

Universities:

KU – Klaipėda University

KTU – Kaunas University of Technology

Vilnius Tech – Vilnius Gediminas Technical University

VU – Vilnius University

¹ Description of the Comparative Expert Assessment of Research and Development Activities by Universities and Research Institutes approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021

1. INTRODUCTION

1.1. Purpose, Scope, Goals of the Comparative Expert Assessment

The Comparative Expert Assessment of research and development activities carried out by universities and research institutes of Lithuania (hereinafter – CEA) was carried out in 2023 by Research Council of Lithuania (hereinafter – RCL) in accordance with the *Description of the Comparative Expert Assessment of Research and Development Activities by Universities and Research Institutes* approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021 (hereinafter – the Description), the *Regulation on Procedures for the Comparative Expert Evaluation of Research and Development Activities Carried out by Universities and Research Institutes* approved by Order No V-486 of the Chair of the RCL of 8 August 2022 (hereinafter – the Regulation), and other related legislation.

The purpose of CEA is to provide a picture of research and development (hereinafter – R&D) performance, socio-economic impact, and the development potential of Lithuanian universities and research institutes (hereinafter – Institutions) based on their R&D activities during the period of 2018–2022.

The scope of CEA encompasses both state and non-state Institutions operating in Lithuania. All state universities (in total eleven) and all state research institutes (in total eleven as well), four non-state universities and two non-state research institutes were participating in the CEA in 2023. The Institutions or parts thereof were assessed as the units of assessment (hereinafter – UoA or Units). The CEA facilitates the comparison of R&D performance of the UoA against international standards and within the national context. It provides valuable evidence to R&D policymakers at different levels, as well as offers the Institutions involved in the assessment a significant incentive to enhance their performance.

Since 2018, the CEA has been an integral part of assessment of R&D activities of Lithuanian institutions. The annual assessment of R&D activities carried out by the Institutions together with CEA conducted every five years constitutes the Lithuanian assessment system of R&D activities. The results of the two-step assessment are used to allocate state funding for R&D activities for Institutions. The results of the CEA implemented in 2023 will determine 70% of state budget funding for R&D activities of Institutions for the subsequent five years.

The assessment results will also determine the continuity of doctoral studies as well as the new rights to carry out doctoral studies at Institutions in accordance with the *Regulations on Doctoral Studies* approved by Decision No. V-739 of the Minister of Education, Science and Sport of 18 May 2020. Moreover, the findings from the CEA might serve as a trusted source of evidence on R&D performance of the Institutions for assessments concerning other funding instruments or higher education studies.

1.2. Comparative Expert Assessment Organization and Assessment Criteria

The CEA relies on international peer review panels to evaluate Lithuanian Institutions' R&D activities. Using panels rather than individual peers creates a possibility for discussion and debate within the peer group and enabling comparison within the group.

The assessment is carried out on the UoA level, which is the organisationally defined structure – ranging from a whole Institution to a division of an Institution corresponding to the faculty or other formal structures of the Institution. In accordance with the Description the rules for the formation of the UoA are as follows:

- the UoA should be interrelated by common R&D activities and might operate in one or two research areas;
- the minimum size of the UoA should be no less than 5 full-time researchers with scientific degree (FTE(SD)) and the maximum size of UoA should not exceed 75 FTE(SD).

The exceptions could be made for better reflection of R&D activities in the Institution. If an Institution had a UoA with a higher number of FTE(SD) or/and UoA operated in three research areas, it should have submitted arguments and obtained RCL approval for participating with not typical composition.

Following the instructions, Institutions have formed eighty-five UoA. All these UoA were split into thirteen groups resulting from four to nine UoA per Panel. The interval of the UoA size ranged from slightly above 5 FTE(SD) to UoA of more than 150 FTE(SD). The number of research areas and research fields one UoA was operating in also varied, i. e., while most UoA operated in one or two research fields, there were outliers where Units were involved in up to five research fields. The variations in size, composition, and research areas among the UoA within each group posed challenges for comparison and required careful consideration by the Expert Panel.

The assessment of the Units is based on three criteria:

- The quality of R&D activities (weight 0.65) of UoA in the research field(s) (group of research fields);
- The economic and social impact of R&D activities (weight 0.2) of UoA;
- The development potential of R&D activities (weight 0.15) of UoA.

The quality of R&D activities is assessed either in each research field or the group of research fields within the research area while economic and social impact as well as development potential are assessed on the UoA level. Each assessment criterion is scored on a five-point scale, namely, ranging from excellent [5] to poor [1] or no R&D [0]. The description of the values of the scores for each criterion are provided in the Description. Half point scores were allowed, and that provided a possibility for more nuanced assessment when necessary.

The quality of R&D activities of the Unit is assessed following these rules: if UoA has at least 10 FTE(SD) in the research field or has between 2 and 10 FTE(SD) and has the right to provide doctoral studies (or intends to seek such right in the next 5 years) in the research field, then the research quality is assessed in the research field; if UoA does not meet these criteria, then the research quality is assessed in the group of research fields within the research area. In the latter case, the assessment considers the collective quality across the research fields within the group.

The assessment was based on the material provided by the UoA to the RCL information system “Vieversys” and covered the period 2018–2022, as well as summarized results of the annual assessment of R&D activities of Institutions (for 2018–2021) provided by RCL, alongside the information obtained during the visits of the Panels to the Institutions and meetings with the representatives of the UoA. Following the Description and the *Procedure for the Submission of Data on Results of Research and Development Activities Carried out by Universities and Research Institutes for the Comparative Expert Assessment* approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021 (hereinafter – the Procedure for Submission of Data) relevant data was examined when assessing the UoA against each of the CEA criteria. In most cases the number of provided outputs for the assessment depended on the size of the UoA varying from a minimum of five to maximum of eighty-two outputs.

It should be noted that since the previous round of CEA in 2018, several organisational improvements of assessment have been made, therefore caution should be exercised when comparing the results of these two assessments. Some of them are worth mentioning:

- 85 UoA were formed and grouped into 13 Expert Panels in 2023, while the first CEA resulted in 117 UoA formed and grouped into 6 Expert Panels. The cause is mainly due to the change of rules for setting up a UoA. During the 2018 CEA, forming a UoA was allowed in only one respective research area, i. e., if the UoA operated in two research areas, it had to be split into two Units for the assessment purposes. In 2023 this restriction was eliminated, and Unit could easily operate in two (and in some cases in three) research areas. As well UoA formation was influenced by changing landscape of Institutions during the assessment period as mergers of several institutions took place: Aleksandras Stulginskis University and the Lithuanian University of Educational Sciences merged with Vytautas Magnus University since 1st January 2019; Šiauliai University was merged with Vilnius University, as well as the Institute of Law, the Lithuanian Institute of Agrarian Economics and the Lithuanian Social Research Center were merged into Lithuanian Centre for Social Sciences since 1st January 2021.
- The CEA scoring system has also undergone some changes. While five-point scales were used in both assessments, in 2023 half points were allowed, while in 2018 only whole numbers were used.
- There were some changes in the requirements for documentary input. In 2023 one list of Unit's R&D outputs for a five-year period was required while in 2018 a list of R&D outputs for each assessment year (from 2013 to 2017) and an additional list for the entire assessment period were required, resulting in a large volume of data.

1.3. Expert Panel for the VV_GR_NT_2 Group of Units of Assessment

Expert Panel for the VV_GR_NT_2 group had to assess five UoA from four Institutions:

- **Klaipėda University** – 1 UoA:
Technology and Natural Sciences (abbr. *KU_JTGM*);
- **Kaunas University of Technology** – 2 UoA:
Electrical and Electronics Engineering (abbr. *KTU_Elekt(ronik)a*),
Computer Science and Mathematics (abbr. *KTU_IT-math*);
- **Vilnius Gediminas technical university** – 1 UoA:
Electronics and Informatics (abbr. *VilniusTech_EI*);
- **Vilnius University** – 1 UoA:
Mathematics and Informatics (abbr. *VU_MIF*).

The Units were operating in the Mathematics, Informatics, Informatics engineering, Chemical engineering, Transport engineering, Electrical and electronic engineering, Measurement engineering research fields, and considering these research fields RCL has appointed the Expert Panel members with the main responsibility to assess UoA against three criteria and provide recommendations for UoA future development. The Panel consisted of eleven members affiliated with institutions abroad:

- Erkki Ikonen (*Panel Chair*), Aalto University, Finland
- Risto Ilmoniemi, Aalto University, Finland
- Nima Eshaghi Gorji, Technological University Dublin, Ireland
- Aleš Leonardis, University of Birmingham, United Kingdom
- Giulio Jacucci, University of Helsinki, Finland
- Bojan Dolžak, University of Maribor, Slovenia
- Jan Holnicki-Szulc, Institute of Fundamental Technological Research - Polish Academy of Science, Poland
- Giuseppe Buttazzo, University of Pisa, Italy

- Dawid Janas, Silesian University of Technology, Poland
- Hans-Liudger Dienel, Technische Universitaet Berlin, Germany
- Vladimir Muller, Institute of Mathematics of the Academy of Sciences of the Czech Republic, Czech Republic.

1.4. Assessment Organization for the VV_GR_NT_2 Group of Units of Assessment

Timeline of the assessment organization for the VV_GR_NT_2 Group of UoA:

Submission of data. Institutions participating in the VV_GR_NT_2 Group submitted data on R&D activities of their UoA to the information system “Viewersys” by the 9th of March 2023 following the Procedure for Submission of Data.

Individual assessment. Prior to the visit to Lithuania, the data of each UoA submitted for the assessment was individually evaluated by at least three experts from the Panel. The number of experts assigned to assess each UoA would increase based on the number of research fields within the UoA. The individual assessment of the Units within the VV_GR_NT_2 Group was conducted till 7th of April 2023.

Visit to Lithuania. The Panel members for the VV_GR_NT_2 Group visited Lithuania from 17th to 21st of April 2023. The main objectives of the visit included discussing the results of the individual assessment within the Expert Panel, ensuring a uniform and consistent application of the assessment criteria among the Panel members; visiting and familiarizing with the academic and administrative staff, PhD students, and research infrastructure of the UoA (at least three experts from the Panel had to visit one UoA); and collectively agreeing on all scores for the Units within the group in the joint session.

Final report. After the visit to Lithuania, the preparation of the Panel report took place. The coordination of the preparation was done by the Panel chair. Before the submission of the Panel’s report, the institutions were given an opportunity to provide comments on the factual errors if any observed in the written justification of the scores for UoA. Taking into consideration the comments, the Panel's report has been adjusted where necessary. In addition, the Panel prepared a reply to the commenting authorities. The report was submitted to the RCL with the agreement of all Panel members.

Appeals. Upon receiving the final results on each Unit, the Institutions had the right to submit a substantiated appeal to the RCL if they believed there were factual errors in the justification of the UoA assessment and/or if they suspected a breach of the assessment procedures that may have affected the assessment outcome.

RCL has established an external Board of Appeal, comprised of seven members selected from the candidates nominated by the Lithuanian Research Academy, the Conference of Rectors of Lithuanian Universities, the Conference of Directors of the Lithuanian National Research Institutes, and the Ministry of Education, Science, and Sports. The Board of Appeal was responsible for determining whether the appeals adhered to the specified provisions and in case of favourable decision to examine the appeal thoroughly.

The Panel VV_GR_NT_2 has received one appeal. The Board of Appeal dismissed the appeal due to non-compliance with the established appeal provisions.

Approval of the report. The final report of the VV_GR_NT_2 group is approved by the Order of the Chair of the RCL in accordance with the Regulation.

2. ASSESSMENT REPORTS

2.1. KU_JTGM Unit of Assessment

Name of the institution	Klaipeda University
Official abbreviation of the name of the institution	KU
Name of the Institution's unit of assessment (hereinafter – UoA)	Technology and Natural Sciences
Abbreviation of the UoA name	KU_JTGM
The scope of the UoA (FTE(SD))	32,74
Research area(s)	T 000 - Technology, N 000 - Natural sciences

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 007 - Informatics Engineering	8,00	2,5

Reasoned justification of the score

Currently, the research field does not offer PhD studies, but there are plans to do so in the next five years, which may be even too ambitious. On the other hand, considering rapid development of this area, offering PhD studies would make sense and be beneficial for future R&D output, particularly if Information Engineering (Technology) would take the advantage of performing R&D activities in more close cooperation with Informatics (Natural Sciences) at the same department, as two small research groups at the same UoA, neither of which offer PhD studies, do not appear to be efficient in this regard.

The research outputs in terms of original scientific articles and conference papers are of an average standard, lacking any particularly noteworthy accomplishments. Furthermore, the first two reported articles published in scientific journals are very similar to each other (addressing the same research issue of detecting shipping container impacts with vertical cell guides inside container ships during handling operations, published by the exactly the same list of authors in two different journals in year 2022). When comparing the research results of this field with those of a related field in the natural sciences, it becomes clear more cooperation between both fields related to informatics would be beneficial. The combined results would not only be consolidated, but also enhanced.

The only international award received was the second place in the International Hackathon Portathon Baltic, while all other reported awards were at the national level.

Low funds received from R&D international programmes. Currently, there are three ongoing R&D projects in the field, with a total budget of approximately EUR 1.085 mil., including one Horizon. In the last five years,

two R&D projects were completed, with a combined budget of approximately EUR 900 thous. Among them, one was Interreg.

To summarize the evaluation of the quality of R&D activities in the research field, it can be concluded that the performance of R&D activities is satisfactory and recognised primarily at the regional level, and to some extent also at the national level. However, to attain recognition on an international level, it will be essential to invest additional effort in publishing in more distinguished international journals, participating in more relevant conferences, and encouraging more extensive international mobility of researchers while simultaneously attracting foreign experts to work at the UoA. These prerequisites are essential for making plans for a robust doctoral study program at the international level realistic.

Research field	Scope (FTE(SD))	Score (points)
T 005 - Chemical Engineering	5,87	3

Reasoned justification of the score

The research field currently does not provide PhD studies, but there are intentions to offer them within the next five years. Due to limited human resources, this may pose a challenge, although some R&D results achieved in the last evaluation period provide a solid foundation for at least a small-scale PhD program, which would contribute to even more recognizable R&D results and increase the research potential of the field. However, presently the field heavily relies on a few enthusiastic individuals. In order to establish a substantial capacity for international-level PhD studies, it is imperative to expand and fortify the research team.

Although the majority of the research outputs in terms of original scientific articles and conference papers are of an average standard, there is one EU patent application reported that stands out and is worth highlighting. Despite the field's focus on applied research, this should not lead to inferior publications. It is important to have appropriate agreements with clients regarding publication of research findings. In cases where clients do not want results to be published, filling a patent application can be an adequate alternative to the scientific articles.

Numerous awards are reported, primarily on a national level. One notable mention could be the Elsevier Reviewer Recognition Award, which was received for six reviews over a six-year period. Additionally, a documentary film about the science in Lithuania showcased their invention and spin-off company.

Low funds received from R&D international programmes. Currently, there are two Interreg R&D projects in progress in the field, with a total budget of approximately EUR 286 thous. In the last five years, three R&D projects were completed, with a combined budget of approximately EUR 460 thous. Among them, two were Interreg.

To summarize the evaluation of the quality of R&D activities in the research field, it can be concluded that the performance of R&D activities is of high level and recognized both locally and nationally. However, to attain recognition on an international level, it will be essential to invest additional effort in publishing in more distinguished international journals, participating in more relevant conferences, and encouraging more extensive international mobility of researchers while simultaneously attracting foreign experts to work at the UoA. Only then will the conditions be met for an internationally comparable doctoral study, which could further strengthen the research field and give it a new impetus.

Research field	Scope (FTE(SD))	Score (points)
T 003 - Transport Engineering	5,58	3,5

Reasoned justification of the score

Transport engineering is the only research field at UoA that offers PhD studies. Due to limited human resources, the unit is running a small-scale program with fewer than 10 enrolled students. Actually, it is a joint PhD program with three other Lithuanian universities. Despite its small scale, offering PhD studies represents an added value and comparative advantage over the other fields that do not provide this opportunity, as involving young scientists in basic research through PhD program is beneficial to enhance the R&D output of the field. Five students have successfully completed their doctoral studies so far, including one part-time student. During the assessment period the first foreign doctoral student was admitted in 2021. All doctoral students, including the foreign one, finished their second cycle studies at the same University. Although the number of PhD theses produced is small, they are well structured and persuasive, with clearly defined scientific novelty and extensive referencing.

The primary research topics are intricately linked to the port of Klaipėda. While the emphasis mostly remains on the national level, the outcomes gradually extend to an international scale. The research outputs in terms of original scientific articles and conference papers are of an average standard, lacking any particularly noteworthy accomplishments. In addition, it is worth noting that four out of five research papers are published in the same MDPI journal. Given the presence of a doctoral study program, the research output should be more compelling. It is clear that stricter conditions will need to be put in place for the defence of doctoral dissertations. Currently, two papers are required to be published in journals with impact factor where rank of journal is not prescribed.

All reported awards are at the national level.

Low funds received from R&D international programmes. At present, there is only one R&D project in progress with a budget of approximately EUR 17.3 thous. In the last five years, a total of four R&D projects were completed with a combined budget of roughly EUR 1.17 mil. Out of these, two projects were funded by European sources, but the majority of the funds came from the project in partnership with Research Council of Lithuania, amounting to EUR 0.7 mil.

To summarize the evaluation of the quality of R&D activities in the research field, it can be concluded that these activities have achieved a high level of performance and are primarily acknowledged at the national level. In the last assessment period, there has been a gradual recognition of their significance at the international level as well. To attain wider recognition at the international level, it will be essential to invest additional effort in publishing in more distinguished international journals, participating in more relevant conferences, and encouraging more extensive international mobility of researchers while simultaneously attracting foreign experts to work at the UoA.

Group of research fields within the research area	Scope (FTE(SD))	Score (points)
T 009 - Mechanical Engineering	7,10	3
T 001 - Electrical and Electronic Engineering		
T 002 - Civil Engineering		

Reasoned justification of the score

The group of research fields, comprising about 7 FTE(SD) spread across three departments, faces limitations in achieving global excellence in their respective areas of research. As a result, they prioritize the utilization

of existing resources to enhance transport and maritime technologies, while also strengthening applied regional focus.

While most of the research outputs in terms of original scientific articles and conference papers are of average quality, there is one standout research article that was published in a journal with an impact factor of more than 6. Additionally, the contribution presented at the world congress in Poland was published in the proceedings by Springer. These examples set a high standard that other researchers in the field and throughout the UoA should aim to follow.

Previously mentioned conference paper was also awarded for the Best Application Paper. In addition to this international award, five other awards were received, including the Lithuanian-American Innovation Award and an award for the student team project "Pneumobile" in Hungary.

Low funds received from R&D international programmes. Over the past five years, a total of five R&D projects were finished, with a collective budget of about EUR 1.146 mil. Among these, three projects were Interreg, and one was Erasmus+. Presently, there are no ongoing R&D projects reported.

To summarize the evaluation of the quality of R&D activities in the group of research fields, it can be concluded that the performance of R&D activities is of high level and recognized both locally and nationally. However, to attain recognition on an international level, it will be essential to invest additional effort in publishing in more distinguished international journals, participating in more relevant conferences, and encouraging more extensive international mobility of researchers while simultaneously attracting foreign experts to work at the UoA.

Natural sciences

Research field	Scope (FTE(SD))	Score (points)
N 009 - Informatics	6,19	3

Reasoned justification of the score

Taking into account the available human resources, the Informatics research field shows a good progress in the last assessment period. The field does not offer PhD studies, but there are plans to do so in the next five years. Considering rapid development of this area, offering PhD studies would make sense and be beneficial for future R&D output. Furthermore, it is crucial to leverage the potential for scientific collaboration with the Informatics Engineering field that exists within the same department.

The research outputs in terms of original scientific articles and conference papers are the best within the whole UoA. However, the small size of the research group limits the number of publications, and thus their overall impact. This reinforces the need for more cooperation between both fields related to informatics to increase the research potential. The reported five original scientific articles were published in high-ranked CA Web of Science JCR journals (Q1). Moreover, one out of the three conference papers was presented as an invited lecture during the plenary session.

Only two awards are reported, both were received at the national level.

Currently, there is one Horizon R&D project in progress in the field, with a total budget of EUR 273.575. In the last five years, a total of four R&D projects were completed, with a combined budget of approximately EUR 1.36 mil. Among them, one was Interreg, and two were financed through EU funds.

To summarize the evaluation of the quality of R&D activities in the research field, it can be concluded that the performance of R&D activities is of high level and recognized both locally and nationally. However, to

achieve recognition on a global scale, it will be necessary to broaden the researcher pool by working closely with another group within the same UoA, encouraging greater international mobility among researchers, and simultaneously attracting foreign experts to work at the UoA. Only then will the conditions be met for an internationally comparable doctoral study, which could further strengthen the research field and give it a new impetus.

Economic and social impact of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

Despite limited funding from economic entities, the UoA has achieved significant success in conducting several interesting R&D projects that have had a positive impact on Lithuania's socio-economic environment, highlighting the UoA's role as a valuable partner in R&D beyond the academic community. These projects have resulted in the development of prototypes and the establishment of start-ups developing products that are almost ready for the market, showcasing good practice.

The UoA's location has enabled it to focus on technologies related to the port of Klaipėda, including autonomous green ports, smart wireless security systems, biotechnological in-situ treatment methods for oil spills, energy and maritime transportation, smart software productivity bots, hydrogen utilization technologies in maritime transport, district heating, and charging infrastructure for e-cars. These studies have facilitated the region's development, and even though they do not have a global impact yet, they hold great potential for the future.

Many UoA researchers actively participate in various organizations, including national and international entities, and provide consulting work in different fields such as energy, transport technologies, agriculture, waste recycle, AI, and machine learning applications. The researchers' expertise has been requested by parties from abroad, although the long-term impact of these collaborations or the possibility of applying for grants for further developments remains unclear.

The UoA has co-organized scientific conferences and events and its researchers have served on the editorial boards of scientific journals, including one published by the university. However, most of the journals joined by scientists from UoA have limited impact.

The researchers are also members of international working groups, including the European University for Smart Urban Coastal Sustainability, Lithuanian Clean Technologies Cluster, European Structural Integrity Society, The Cross-Border Green Technologies Cluster, IEEE, European Biomass Industry Association, American Society of Mechanical Engineers, and American Society of Civil Engineers.

While the UoA has made efforts to popularize its research results through various events aimed at sharing knowledge with non-experts, the number of students and the amount of applied research projects and funding have decreased in recent years, indicating the need for even more intensive promotion activities.

The researchers have formed numerous cooperation agreements with economic entities, including international agreements and agreements with a spin-off company, highlighting the value and importance of the researchers' know-how for society. However, the lack of critical details regarding sharing results, intellectual property issues, financial contributions, etc. in the description of these agreements is concerning.

The UoA's close relationship with the academic community, businesses, decision-makers, and society is apparent, but more researchers should be active in extending the economic and social impact of R&D activities, also at an international level.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA has good infrastructure with ambitious plans for further development, including a new laboratory building. Infrastructure includes very specialized tools for maritime and energy research, including the Marine engineering and shipping laboratory of seaports with 3D visualization, Fuel and fuel properties research laboratory, and many other technologies and prototyping environments. The R&D infrastructure may require upgrading to bring edge-cutting technologies for enabling the researchers to compete with international research groups.

The university has adopted a promising development strategy leveraging Klaipėda's strategic position as the only port in Lithuania. The potential for development of R&D activities in the Faculty of Maritime Technologies and Natural Sciences is good. The R&D themes are ambitious and relevant to the current environment. However, the vision of how the UoA wants to position itself in global science in the upcoming future is not entirely clear. The publication dynamics should also be defined more ambitiously. Furthermore, there is insufficient information about plans for grant applications that can fund the R&D themes to be developed by the UoA.

The university has access to other open access infrastructure including supercomputer in Vilnius and participates in national and international research and development infrastructures. The EU University Network EU-CONEXUS shows benefits of synergy between localization, maritime R&D activities, and well-motivated research staff.

The Human resources structure is satisfactory, but the number of early-stage researchers is rather small, and women are slightly underrepresented. The human resource principles are well thought out with different contractual and career options with period assessments. Recruiting is also appropriate, with public competitions. Teaching staff has rather heavy teaching load allowing them only approximately 33% of their workload devoting to research activities.

The UoA's SWOT analysis is sufficiently thorough, representing the strengths, weaknesses, opportunities, and threats of UoA. However, the documentation does not fully explain the envisioned mitigation strategies to reduce the anticipated risks. The most significant challenge is attracting new researchers from Lithuania and abroad.

Klaipėda, as a port town, is an ideal location for applied technical research on logistics with special emphasis on marine logistics. Thus, it is not surprising that maritime research is the centre of many R&D activities at UoA. Safe and green maritime transport, considering new technologies like electrical and hydrogen propulsion and maritime energy stations supplying ships in long-distance trips, is a global future challenge option. However, more students and researchers need to be involved in these R&D activities.

Taking into account grades for quality of the R&D activities of the UoA in the last period, the potential in the next 5 years to achieve very good ratings is realistic.

Recommendations for continuity and/or improvement of the activities of the UoA

The assessment panel acknowledges the UoA's progress in R&D activities during the last evaluation period, which were mainly focused on applied research. To take advantage of the UoA's location, specific research fields, and potential, we recommend the following measures to be considered for continuity and further improvements in R&D activities:

- Focus on the research fields where the UoA has sufficient human and infrastructure resources and potential to contribute to cutting-edge research. Based on the present R&D research output, the leading departments should be Transport engineering and Chemical engineering, with other departments providing specific support.
- Extend locally oriented R&D activities to the international level. Most of the results achieved in the last evaluation period could be presented at more prestigious conferences and published in more prominent scientific journals.
- Attract PhD students who completed their master's studies elsewhere but at the UoA (at other Lithuanian universities or abroad).
- Spend some project funds on additional PhD students (not funded by State budget or the Research Council of Lithuania), possibly from abroad.
- Encourage PhD students to pursue post-doctoral studies at UoA after completing their doctoral studies.
- Encourage researchers (also with promotion prerequisites) to publish the results of their research in high-impact journals and top-ranked conferences, possibly also as invited speakers.
- Require researchers to spend a longer period working abroad at renowned world universities or institutes as part of the recruitment and promotion strategy (one week at the time is not enough).

2.2. KTU_IT-math Unit of Assessment

Name of the institution	Kaunas University of Technology
Official abbreviation of the name of the institution	KTU
Name of the Institution's unit of assessment (hereinafter – UoA)	Computer Science and Mathematics
Abbreviation of the UoA name	KTU_IT-math
The scope of the UoA (FTE(SD))	51,26
Research area(s)	T 000 - Technology, N 000 - Natural sciences

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 007 - Informatics Engineering	25,01	3,5

Reasoned justification of the score

The UoA KTU_IT-math in the research field of Informatics Engineering (Technology) has demonstrated R&D activities carried out over the evaluation period of high level, nationally well recognized; however, with moderate international recognition.

The main research areas include computer systems and networks, software engineering, internet of things, cybersecurity, HCI, computer vision and graphics and AI applications. The teaching staff with a scientific degree quite outnumber the researchers with a scientific degree, which has a detrimental effect on stronger research outcomes, both in terms of quality and quantity. Also, there is a lack of more junior researchers as well as researchers from abroad.

Data on doctoral studies by the research field Informatics Engineering shows a rather constant number of PhD students and the number of completed studies throughout the last evaluation period. There is evidence of an increase in the number of foreign students. Also positive is that the complete theses are written in English rather than just summaries, which has contributed to wider dissemination.

The list of the best research outputs includes an EU patent on indoor positioning of WLAN devices, a patent application on an algorithmically optimized method to supply a feeding substrate to a bioreactor, a monograph "Smart STEM-driven computer science education: Theory, methodology and robot-based practices", which has a modest number of citations, and several publications in international journals (notable is the number of IEEE publications). The quality of the publications is good, however, not at the top of the ranking in the respective research fields, which is also evident from a relatively modest number of citations. The list of the best reports delivered at conferences abroad shows a steady participation at international events. What is missing are some really top selective specialized conferences with high impact as well as invited and plenary speeches. The list of the main national and international awards received for R&D demonstrates recognition of some of the achievements (e.g., "Silicon Valley Innovation Challenge"). The

details on participation in competition-based R&D projects show involvement in the EU H2020 activities; however, more ambition should be put on more prominent roles, e.g., coordination, leadership.

Natural sciences

Research field	Scope (FTE(SD))	Score (points)
N 001 - Mathematics	13,56	3

Reasoned justification of the score

The Mathematics research field of the UoA has demonstrated R&D activities carried out over the evaluation period of high level, nationally well recognized, however, with limited international recognition.

The main research themes in the section are operational research, mathematical modelling in biomedicine and in engineering, data science and statistics, with connections to several applications. The Mathematics research field is quite well connected with the other fields of the UoA in Informatics and in Informatics Engineering, and the collaboration among scientists is well established.

Among the selected publications presented in the Unit's report several ones are of a good level, even if not in the top international journals, in a rather large part addressed to applications of mathematics. Similarly, the best reports delivered at qualified conferences abroad are of a good level and show the interest of the Mathematics field in topics as nonlinear dynamics and complexity, engineering and technology innovation, financial mathematics, biophysics, image analysis, water management.

The list of main national and international awards received show that some members of the Mathematics field have a good recognition by the scientific community. The list of participations in competition-based R&D projects is also good, with involvement in financial technologies, health monitoring, study of human fatigue, risk management, stochastic pandemic models, DNA mechanics models, models for pension funds in uncertain environments.

There is no PhD program in Mathematics, which is a serious problem for training future new scientists. This issue has to be solved in the future, since having a doctoral school is crucial to perform research of a high level.

During the visit it became evident that, since mathematics courses are important for a number of disciplines, the teaching load, especially in undergraduate studies, is very high and sometimes is an obstacle to perform high-level research. A more balanced distribution of researchers among the various fields of the UoA and of the teaching load among the members would probably make the problem less dramatic.

Research field	Scope (FTE(SD))	Score (points)
N 009 - Informatics	12,69	3

Reasoned justification of the score

The UoA KTU_IT-math in the research field of Informatics (Natural Sciences) has demonstrated R&D activities carried out over the evaluation period of high level, nationally well recognized, however, with limited international recognition.

The research field group is relatively small. The main research areas include multidisciplinary mathematical models, optimisation algorithms and system formalisation. The teaching staff with a scientific degree quite outnumber the researchers with a scientific degree, which has a detrimental effect on stronger research

outcomes, both in terms of quality and quantity. Also, a weakness is that there is no evidence of researchers from abroad. On the positive side, there is a good balance between senior and less senior positions, i.e., professors and associate professors.

The data on doctoral studies by the research field Informatics shows a rather constant number of PhD students and the number of completed studies throughout the five-year period. There is evidence of some foreign students, however, their number is still quite modest.

The list of the best research outputs includes articles in qualified journals, including Applied Mathematics and Computation and Sensors; however, while internationally recognised journals, they are mostly not at the top of the ranking in the respective research fields, which is also evident from a relatively modest number of citations that the papers have received.

The list of the best reports delivered at conferences abroad demonstrates the participation at the international level, however, there is no evidence of plenary talks or keynote speeches. What is also missing are some really top selective specialized conferences with high impact.

The list of the main national and international awards received for R&D demonstrates recognition mostly at the national level; however, a best paper award at a conference is acknowledged.

Economic and social impact of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

The UoA has carried out research that has had important economic and social impacts. As such, the UoA has been an important partner in R&D also outside the academic community.

The list of research outputs, R&D orders of economic entities (Lithuanian and foreign), and projects (international or national) includes projects such as SPARTA (related to cybersecurity), GÉANT, FIN-TECH (related to finance sector), BIM-LT (with impact in construction sector). Also notable are the contributions to the modernization and development of the National forest inventory information system, biotechnological processes, and robotic technology in agriculture. H2020 EQUAL-IST has had an impact on gender equality. The list of the most important cases of participation of researchers representing the UoA in working groups, commissions or committees set up by state authorities, state and municipal institutions, enterprises and organisations, and economic entities include membership in the working group at the Ministry of Economy and Innovation, in the Cybersecurity Council, in Centre For Quality Assessment In Higher Education, National Agency for Education, Ministry of Education, Science and Sport (to name a few). The UoA has provided consultations to the public or economic entities, including (among others) Prodentum company, Optitecha company, Topo grupė company, State forest service and National Cyber Security Center. The list of the most important scientific conferences and events organised by the UoA demonstrates a broad portfolio of different events at different levels and targeting different groups (e.g., more junior groups). The list of the most important cases of participation of researchers representing the UoA in editorial boards of scientific journals shows a good involvement, however, some more prestigious journals are not among them. The list of the most important cases of membership of researchers representing the UoA in international working groups and associations shows good representation, however, there is no evidence of taking more prominent roles besides being members. The UoA has also a proven record of activities popularising science. There is evidence of a substantial number of cooperation agreements between UoA and economic entities, however,

the monetary effects are not evident. The UoA has good infrastructure and ambitious plans for further development. Also notable is the positive attitude towards outer integration and expansion.

The development potential of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

Considering the UoA's current performance, the human resources, strategy and organisation of activities and infrastructure, there is a potential for the UoA to achieve ratings between good and very good in the next five years. Age distribution is relatively good; however, gender balance should be improved. Human resources management principles of the UoA (recruitment, promotion, organisation of work) are appropriate and aligned with similar institutions worldwide. The academic staff evaluation system includes a five-year performance evaluation and an annual evaluation review, which should strengthen the quality. The career paths are well planned. The UoA invests in continuing and professional development. However, an area to be strengthened includes mobility of researchers.

The infrastructure represents a good basis for further development of R&D activities. It includes state-of-the-art research facilities in the fields of engineering, technology, and computer science, distributed across 9 faculties and 8 institutes of the University. The construction of the new laboratory centre, "Centre for Experimental and Prototyping Laboratories in Physical and Technological Sciences – M-Lab", started in 2021. The KTU library is also an important part of the infrastructure, which includes physical as well as digital collections.

Two projects of the European Horizon Programme's funding instrument Teaming for Excellence are starting in spring 2023. The University will also establish an international centre of excellence for artificial intelligence in Lithuania. Also commendable is the participation of the KTU in the European Organisation for Nuclear Research (CERN) as a member of the CERN-LT consortium.

The UoA has put forward a SWOT analysis which is realistic and detailed, and the strategic documents are of good quality. The policy for the training of the new generation of researchers is well conceived. Description and justification of the R&D themes to be developed by the UoA is appropriate, however due to the current rapid progress, especially in the area of artificial intelligence (AI) and machine learning (ML), these plans may need further revisions/updates in the mid-term future (e.g., related to developments of LLMs and foundation models). Perhaps also to be considered are some interdisciplinary themes that will dominate the future (e.g., ecology, meteorology).

While in general the potential of the UoA for further development is good, strengthening the excellence in basic science and R&D efforts is needed to further improve the potential. Also, while collaborations in large European networks are commendable, it would be important for the UoA to identify niche areas where the researchers of the UoA can take a leading role. Also, the future development is intrinsically related to the quality and further development of doctoral schools.

Recommendations for continuity and/or improvement of the activities of the UoA

The members of the Panel acknowledge that substantial progress has been achieved during the evaluation period. Over the years of the evaluation period the research outputs have progressively increased both in quantitative as well as qualitative terms. There are clear indications that the research evaluation criteria put forward by the Research Council of Lithuania as well as internal promotion rules defined by the UoA have significantly shaped the directions of the priorities of the types of research outputs that the researchers have been pursuing. The internal UoA mechanisms that reward extra teaching (on top of the regular teaching load) might have also adversely impacted the research outputs. Similarly, smaller projects that are not completely within the scope and focus of the research groups and are pursued primarily for some short-term monetary gains, can present a distraction in terms of striving for research excellence and highest possible impact, both nationally as well as internationally. Based on the above, Panel recommend the UoA to:

- Improve the excellence in basic science and R&D. Quality should become the dominant factor. The UoA should target the top journals as well as the top-ranked high-impact conferences in the respective research fields. The UoA should introduce awards and base internal promotions on excellence and impact (e.g., citations) rather than quantity of more mediocre publications.
- Strive for closer integration with the international research community. Researchers should be encouraged to take sabbaticals (a study year that should mostly be spent abroad working at prestigious world universities or institutes). Having experience of working abroad should also be part of the recruitment strategy and promotions. Newly established centres of excellence should form strong Advisory Boards from abroad.
- Aim to participate in R&D EU / international projects with strong research partners. The EU Commission has special calls for the universities from smaller countries to join already running/approved EU projects. The UoA should properly support this with incentives including reduced teaching load, portions of overheads going back to the Principal Investigator's lab for additional research activities, monetary awards, etc.
- Aim to obtain ERC grants. While the members of the assessment Panel acknowledge the difficulties in obtaining highly selective ERC grants, the UoA should still strive to provide supporting mechanisms and rewards for the most promising researchers (The EU Commission has special calls for supporting prospective candidates to spend some time with the current ERC grant holders).
- Further improve PhD studies by involving PhD students more regularly in the ongoing projects and encourage PhD students to continue their career with post-doctoral studies after completion. Organise summer schools with participation of speakers from research institutions and industry.
- Timely revisit the research plans and revise them if needed, especially in the rapidly developing areas of AI and ML. Also to be considered are some interdisciplinary themes that will dominate the future (e.g., ecology, meteorology).

2.3. KTU_Elekt(ronik)a Unit of Assessment

Name of the institution	Kaunas University of Technology
Official abbreviation of the name of the institution	KTU
Name of the Institution's unit of assessment (hereinafter – UoA)	Electrical and Electronics Engineering
Abbreviation of the UoA name	KTU_Elekt(ronik)a
The scope of the UoA (FTE(SD))	73,37
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 001 - Electrical and Electronic Engineering	52,01	4

Reasoned justification of the score

The quality of the R&D activities of Electrical and Electronic Engineering of the KTU is of high level in Lithuania and also strong at the international level. Overall, scientists engage in several essential problems in the field, which makes their contributions timely and valuable to other scientists worldwide.

The relatively large UoA conducts doctoral studies in the discipline; on average 3 PhD students graduate a year. It is appreciated that dissertations are commonly written in English. The number of PhD candidates from abroad is relatively high, meaning the Unit is recognized internationally. In the evaluated period, the number of PhD students remained at a similar level, so the Unit keeps attracting new doctoral candidates despite challenging demographics in the country. Researchers with a scientific degree comprise mainly chief researchers – less than an adequate number of research fellows and junior researchers. Larger presence of such employees would definitely facilitate the realization of the scientific goals of the Unit. Nonetheless, the proportion of people devoted to research (35.42 FTE) and teaching (49.76 FTE) is reasonable. Moreover, the fact that all research fellows come from abroad is a good sign in the context of internationalization of the Unit.

The provided list of best research outputs includes many publications in internationally recognized journals, e.g., Renewable and Sustainable Energy Reviews, Construction and Building Materials, or Reliability Engineering & System Safety. However, the selected journals for dissemination are primarily of limited impact – no publications in top interdisciplinary journals documenting ground-breaking research. Many conference contributions at various scientific events abroad (in the European Union and beyond), but the number of invited or plenary lectures is unsatisfactory (only 2 invited speeches, both delivered by the same researcher). Two patents at the international level (US and EU) are a good achievement. The list of awards is quite long and should be evaluated favourably, it includes mostly distinctions at the national level received for R&D activities. The Energy Globe Award 2020 stands out as a significant accomplishment.

Good funding has been received from R&D international programs and from economic entities, including several international grants from the Horizon 2020 Program, EEE Baltic Research Program, ERA-NET, etc. Moreover, several projects were funded by EU Structural Funds and nationally by the Research Council of Lithuania. Currently, the research field has many ongoing R&D projects with a substantial total budget. Hence, the degree of participation in project-related activities is a highlight of this application. Considering the foregoing, given considerable engagement with scientists from abroad, members of the Panel were surprised that they did not find clearly top-quality papers on global scale.

Research field	Scope (FTE(SD))	Score (points)
T 010 - Measurement Engineering	21,36	3,5

Reasoned justification of the score

The field of Measurement Engineering has demonstrated good R&D activities during the evaluation period, gaining high-level recognition nationally. However, its international recognition remains moderate. The research primarily focuses on ultrasonics and its applications in biomedicine and non-destructive testing. The staff consists mostly of experienced chief researchers and professors, both holding scientific degrees, with only one junior researcher among them.

The research field produces an average of one doctoral degree per year, which, considering the nominal study time and the fact that there are approximately 10 doctoral students, indicates a relatively low output and suggests a high drop-out rate or prolonged absences from research. Although there is a small number of international PhD students, it is worth noting that the majority of dissertations are written in English, which is beneficial for dissemination purposes.

While the list of scientific outputs includes several good journal papers, there is a lack of notable highlights, such as publications in top interdisciplinary journals that showcase ground-breaking research. The research field has made contributions to various international conferences; however, none of these contributions were specified as invited or plenary lectures. The awards received for R&D activities are primarily on a national level, although the recognition obtained in the 2020 IEEE International Workshop on Metrology for Aerospace is noteworthy.

Active participation in project realization is a notable aspect of the research field, particularly through grants funded by foreign agencies like the European Commission or Euratom. Additionally, the research field has been involved in projects funded by the EU Structural Funds and the Research Council of Lithuania, highlighting its commitment to securing diverse funding sources.

It is important to note that the research field consists of only 10 to 15 staff members out of some 120 listed fully under the research field of Measurement Engineering. Furthermore, the research topics within Measurement Engineering and Electrical and Electronic Engineering are quite similar, making it challenging to provide an independent assessment of the specific contributions of Measurement Engineering.

In summary, the UoA Measurement Engineering has demonstrated commendable R&D activities, particularly at the national level, but with room for improvement in terms of international recognition. The field has a strong focus on ultrasonics and its applications in healthcare, with a predominantly senior staff comprising chief researchers and professors. While the number of doctoral degrees awarded annually is relatively low, the majority of dissertations are written in English. Notably, the research field lacks ground-breaking publications in top interdisciplinary journals but actively participates in projects funded by foreign agencies and national entities.

Economic and social impact of R&D activities of the UoA

Score (points)

4,5

Reasoned justification of the score

The UoA demonstrated several outputs that can positively impact the economy and society, including a number of solutions for medicine and pharmacy, which involve expertise in the areas of specialization, i.e., Electrical and Electronic Engineering and Measurement Engineering. Moreover, crucial developments were made to advance the field of non-destructive testing of materials, which is of high importance in the technology sector nowadays. Based on the information provided, it is clear that research done at the Unit has a favourable influence on the Lithuanian industry with the possibility of impacting the economies of other countries as well in the upcoming future. Nevertheless, the potential to establish start-up companies has not been exploited to a sufficient extent despite the fact that the UoA has a highly practically oriented focus and many of described outputs are readily exploitable.

Researchers representing the UoA actively contribute their know-how to many entities, which indirectly proves that the activities done at KTU have practical benefits from the national point of view. Furthermore, KTU scientists engage in consultation work with entities from Lithuania and abroad (Spain, Japan, Czech Republic, etc.). Many of these joint activities resulted in the formation of partnerships aiming to submit joint proposals to funding organizations. Nonetheless, the description of the long-term impact of KTU's contribution is, in many cases, unclear.

The Unit promotes dissemination activities by organizing many scientific events, many of which have an international character and also include non-experts (e.g., science festivals) or young researchers (e.g., seminars for students, training sessions, courses), which is appreciated. While several scientists participate as members of editorial boards of internationally recognized journals, these journals are usually of limited impact. Likewise, scientists from KTU are active members of many panels, public bodies, committees, and organizations, many of which are international. Regarding the popularization of research results, it is actively conducted by the UoA but mostly in national media. More focus should be on science popularization activities outside the country to attract foreign researchers to join KTU or engage in international collaboration with foreign universities and research institutes.

Lastly, KTU collaborates with research and economic entities according to several joint activity agreements. This is one of the strong points of the report documenting notable research activity of the UoA in the period of assessment. The methods of sharing results of joint work are usually convincingly explained, so they are positively assessed.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

KTU has development potential to achieve very good ratings in the next 5 years due to the availability of modern infrastructure (a part of which is supported by big companies) supplemented by access to

international research infrastructure. Due to the acquired funding from the European Commission's program Teaming for Excellence, there are clear development opportunities for the upcoming future. By focusing on establishing centres of excellence, KTU may become a major player in AI and IoT technologies in the country (especially since the required fabrication facilities are available). Overall, the UoA has defined specific areas as their future research directions. These areas are vast and seem to cover all activities of the UoA. It is advantageous that the possessed instrumentation is subject to Open Access principles. Due to the involvement of industrial partners, opportunities for further research and career development of KTU scientists are possible. The free economic zone nearby represents an opportunity for further exploration.

Regarding human resources, because many of the employees are between 25 and 34 years old, the Unit has a clear potential to maintain the current level of research activity. The gender is not balanced as women constitute 20% of the whole workforce. Nevertheless, KTU has a convincing strategy for human resource development, including a Gender Equality Plan for 2022-2025. Moreover, the university initiated a campaign to attract more women to engineering fields, which may improve the situation. The career development routes at KTU are clearly defined.

It is welcome that the dynamics of publishing scientific articles show that focus is gradually redirected to publishing papers in Q1 journals – the share of such articles doubled from 2018 to 2022. The number of patent applications also generally keeps increasing. Still, the anticipated number of papers between 2023 and 2025 shows only a small increase with respect to the current count.

Moreover, as the UoA is active in acquiring funds from national and international sources, there is potential for further development. Relevant calls for grant applications were identified. The justification of the R&D themes to be established is convincing and in line with the areas of specialization.

The opportunities for PhD students are also more than appropriate. KTU promotes the training of a broad spectrum of necessary skills to join academia after graduation. Yet, the expected number of foreign PhD students is supposed to decrease, which is a shortcoming. Besides that, the University's plans to integrate new technologies in teaching to reach high-quality studies are unclear.

The SWOT analysis covers most of the expected issues, but mitigation strategies are not provided for all recognized weaknesses and threats in the provided documentation.

Recommendations for continuity and/or improvement of the activities of the UoA

The Panel would like to recognize the efforts of the UoA taken during the assessment period. Clear improvement in many aspects is noted, which increases the recognition of the UoA in the country and outside. Nevertheless, from the international perspective, certain areas still require further work for the Unit to become stronger. Please consider the following suggestions given below:

1. Publications – it is clear that the number of Q1 publications is insufficient. Even more, the documentation lacks truly impactful ground-breaking contributions in top journals, the publication of which could attract considerable attention to KTU by the worldwide community. It is therefore recommended to focus on the quality rather than the quantity of average publications that bring little recognition to the UoA and have a negligible impact on the shape of the discipline.
2. Project activity – while it is overall very good (proven by participation in many Horizon programs), it is a weakness that, given the experience, the UoA does not play the role of coordinator in any of them. Discussion during the interview revealed that, according to the scientists, coordination of EU projects is a “pain”, so there is little interest in directing such research activities.

Consequently, it is recommended that scientists identify the obstacles hindering their ability to submit such proposals and the institution finds a way to implement reasonable solutions to alleviate this problem.

3. Mobility – long-term mobility is not popular. Instead, the researchers tend to participate in short study visits. It was explained that this is the case because of teaching duties. Therefore, this problem should also be handled on the institutional level to unlock the possibility of more active engagement in research done by leading research groups from abroad to bring the best practices back to the country.
 4. Young researchers, PhD students – the number of such scientists could be increased to enhance the development potential of the Unit in the near future. Thus, the UoA should more proactively search for the young generation of researchers and ensure that they consider KTU as an excellent place to do internationally competitive research. Besides that, it is advised to promote participation in post-doctoral fellowships abroad after graduation to develop young researchers. This will also enable the formation of new collaborations needed to increase the impact of conducted research. Obviously, the UoA should consider setting up incentive programs to bring the trained post-docs back to Lithuania from abroad, as this will most considerably catalyse the development of the organization.
 5. Implementation of discoveries – start-up formation should be more encouraged to establish even better socio- economic impact.
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2.4. VilniusTech_EI Unit of Assessment

Name of the institution	Vilnius Gediminas technical university
Official abbreviation of the name of the institution	VILNIUS TECH
Name of the Institution's unit of assessment (hereinafter – UoA)	Electronics and Informatics
Abbreviation of the UoA name	VilniusTech_EI
The scope of the UoA (FTE(SD))	71,67
Research area(s)	T 000 - Technology, N 000 - Natural sciences

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 001 - Electrical and Electronic Engineering	24,48	4

Reasoned justification of the score

The UoA in research field is strong at the international level. R&D carried out is of high level and internationally recognized. The teaching staff with a scientific degree significantly outnumber the researchers with a scientific degree. There is a lack of more junior researchers/lecturers as well as researchers from abroad. Data on doctoral studies by the research field Electrical and Electronic Engineering shows a trend towards a slightly decreasing number of students. The program has an enrolment of around 20 students, with 3 foreign students having been enrolled in the last five years. Outstanding PhD theses are typically written in English, with an extended summary in Lithuanian, using a uniform template with an adequate structure that is strictly followed by all students.

The research outputs are very good. The list of the best research outputs includes two books and a number of publications in international journals. A scientific monograph published by Elsevier (*Phenomena of optical metamaterials*) and a chapter in a book published by John Wiley/Sons (*Disorder in metamaterials*), both by the same author, are notable achievements. The list of the best reports delivered at conferences abroad shows a steady participation at international events, but does not give any indication on keynote/invited talks.

The list of the main national and international awards received for R&D demonstrates some recognition (however not at the highest levels and mostly national). While important, a large number of Certificates related to Master Theses may obscure the other worthy recognitions. Currently, there are 3 R&D projects in the field with a total budget of approximately EUR 610 thous., including 2 international projects. Over the past five years, 9 R&D projects were completed with a total budget of around EUR 2 mil. including one Horizon project.

Recent investment in new equipment for electronic labs opens additional potential for further development of the Electrical and Electronic Engineering branch, especially, in the current crisis situation due to broken

chain of supply for global market of electronic cheeps. Hopefully, so-called Lithuanian High-Tech Zone can be created on the base of academic centres like Vilnius-Tech, Kaunas Technology University and Klaipėda University.

Research field	Scope (FTE(SD))	Score (points)
T 007 - Informatics Engineering	21,70	3,5

Reasoned justification of the score

The UoA in research field is strong with moderate international recognition. R&D carried out is of high level and nationally recognized. In Informatics Engineering field similarly as in Electrical and Electronic Engineering field, the teaching staff with a scientific degree significantly outnumber the researchers with a scientific degree. There is a lack of researchers from abroad. Data on doctoral studies by the research field Informatics Engineering shows a slight decline in the number of students. On the positive side, there is a good proportion of students from abroad. Outstanding PhD theses are typically written in English, with an extended summary in Lithuanian.

The list of the best research outputs includes a number of publications in international journals and a book. The list of the best reports delivered at conferences abroad shows a steady participation at international events. Some really top selective conferences are missing. The list of the main national and international awards received for R&D demonstrates some recognition (however not at the highest levels and mostly national; with a large number of Certificates related to Master Theses). Although conference papers are usually of average quality, the research outputs are very good, with some papers published in high-ranking JCR journals (e.g., papers: A dynamic fuzzification approach for interval type-2 membership function development or A survey on modelling dynamic business processes), and a scientific monograph published by Springer. The majority of awards received are domestic, mainly referring to IEEE awards for supervising recognized master's theses.

The details on participation in competition-based R&D projects show good integration in the projects with international partners, however, there is a strong regional scope. The list also lacks bigger R&D projects with leading/major EU research institutions. Currently, there are 7 R&D projects in the field with a total budget of EUR 3.252 mil., including 5 international projects. Over the past five years, 4 R&D projects were completed with a total budget of EUR 1.134 mil., including one Horizon project.

Natural sciences

Research field	Scope (FTE(SD))	Score (points)
N 009 - Informatics	10,75	3

Reasoned justification of the score

The UoA in research field is strong with limited international recognition. The research and development activities carried out are nationally recognized. However, there is small number of researchers and no researchers from abroad. The number of teaching staff with a scientific degree is relatively low and there is a lack of more junior lecturers. There is extremely low number of PhD students and no students from abroad (such program likely suffers from inefficiency and lack of a critical mass of PhD students to achieve positive

cohort effects). As of now, there are three domestic students enrolled in the program, but no PhD thesis has been successfully defended yet.

The list of the best research outputs includes a number of publications in international journals, but not in the highest ranked journals on global level. The list of the best reports delivered at conferences abroad shows a steady participation at international events, mostly in close by countries. Some really top selective specialized conferences or keynote/invited talks are missing in the evaluation material. The list of the main national and international awards received for R&D demonstrates some recognition (best original research article and two certificates related to Master Theses).

The details on participation in competition-based R&D projects show good involvement in projects, predominantly national, with some funding from abroad. There is a lack of strong R&D projects with major research leaders in the EU and wider. Currently, the research field has 2 ongoing R&D projects with a total budget of EUR 1.638 mil., including one international project. In the past five years, 3 R&D projects were completed with a total budget of around EUR 246 thous., including one Horizon project. Most of the projects are carried out in collaboration with the technological department of this UoA.

Group of research fields within the research area	Scope (FTE(SD))	Score (points)
N 001 - Mathematics	14,74	2,5
N 002 - Physics		
N 004 - Biochemistry		

Reasoned justification of the score

The list of the best research outputs includes several publications in international journals, however, with modest impact factor, not at the top of the respective ranking/also evident from the citations. Some good publications were listed, e.g., MCDM methods using the bayes approach, Journal-of-Symmetry, MDPI AG. However, this open-access journal, although can be a place to showcase the progress in research, does not replace the importance of publishing in recognized journals. MDPI journals are too often observed as the targeted journals. MDPI journals facilitate publishing the research results but still, as a recent publication house, do not reflect the peer-review process as tight and indicative as other established journals in same fields.

The UoA does not carry out doctoral studies in the research fields of Mathematics, Physics, Biochemistry. Hiring new PhD students and engaging them in interdisciplinary topics suggested by scientists of different faculties of this department is encouraged. PhD students working on research topics defined jointly by other EU partners is essential as the joint fundings will require to collaborate to the objectives of the funded projects. Currently there is no international researchers from abroad e.g., at mathematics, physics, biotechnology groups which leads to assessing the international recognition of the group activity to satisfactory level only.

The list of the best reports delivered at conferences abroad shows a steady participation at international events. However, the selected conferences are not of world-class venues. The researchers seem to tend to participate in neighbouring counties mostly which limits their wider international recognition in their research field. More criteria might be required to be placed in choosing the conference venues where the students can network with leading research groups in their field, present to broader audiences in international level and gain insight into the novelties presented in priority areas of study emphasized by the pioneering groups worldwide. The head of the department or the supervisor could encourage delivering

conference presentation to world-class conferences in EU, US or Asia. There is also a lack of top selective specialized keynote/invited talks. The list of the main national and international awards received for R&D demonstrates some recognition (however not at the highest levels and mostly national).

Details on participation in competition-based R&D projects show some involvement in predominantly national projects. There is a lack of strong R&D projects. Presently, the group has 4 ongoing R&D projects, with a total budget of approximately EUR 415 thous., including a joint project with Poland and three national projects. Over the past five years, the group has completed 3 national R&D projects, with a total budget of around EUR 328 thous. The publications of the group are not including the other research institutes engaged in this project even though the project is funded to enhance the research collaboration between the countries. The research exchange could be promoted by receiving and sending the students to visit the other project partners in order to align the performance of the partners to achieve common target. This requires a joint routine and regular meetings of the research partners either in person or remotely, joint publications, joint organization of international conferences (or at least in EU level) and the whole activity should encourage the partners to apply for further joint funding to continue the research initiated from the previous applications.

Economic and social impact of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The Unit of assessment carries out very important scientific research and is a very important partner in R&D beyond the academic community. The research is carried out in cooperation with business partners and is important to society.

The UoA has received decent funding for R&D activities from economic entities, but there is potential for improvement, especially for natural sciences. The university has undertaken many interesting, practically oriented R&D projects with economic and social impact, with most results available in digital form. The staff has been actively involved in various working groups, panels, and committees, with good distribution among academic staff and one foreign membership. The members of the Unit have also provided consultations to the public and economic entities, participated in the organization of many scientific conferences and events, and in scientific popularization activities, including outstanding public media presence. Researchers from the UoA have served on editorial boards of scientific journals, with two journals published by the university, one ranked in Q1 in the field of Mathematics. The Unit has reported many cooperation agreements, not all of them including economic entities.

Number of projects were dedicated to developing frameworks for IOT (Internet of Things), Virtual reality platforms to promote growth in several technological sectors in Lithuania and encourage EU teaming in ICT-related research and innovation. There are projects running for the Development of Tools Aimed to Increase the Efficiency of the Life Cycle Processes of the Public Sector. The societal impact was well addressed by running a project to help strengthening Moldova's aerial border surveillance capability to counter irregular border crossings and their associated risks. A good plan and project to develop a Tool for Monitoring Gender Equality at Municipalities as well as project on planting Information System for Blind and Visually Impaired People. An important aspect of research activities undertaken by the UoA is applicability of these initiatives (with higher Technology Readiness Level (TRL)), then just basic research, leading usually to TRL around of 5

or 6. Collaboration between *Academia and Industry* on the low level of joint research activities is very effective in building so-called Lithuanian High-Tech Zone.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

Having regard to current performance, the human resources, strategy and infrastructure of the UoA, the potential of R&D activities will ensure conditions for at least very good rating in the next 5 years. Especially, cooperation agreements between research and economic entities have been developed from educating master students and running research projects with Baltic academies. Cooperation between academia and industry leads to higher TRL results of the R&D outputs, and this extra parameter should be taken into account in the future evaluation of R&D activities. The additional parameter TRL (Technical Readiness Level – from 1 to 9) should be also taken into account in evaluation of the development potential of R&D activities (together with publications, their citations, etc.). TRL higher than 7 means, that innovative technology (R&D output) can be soon commercialized, generating visibility, intellectual rights to the UoA and potential for further R&D development.

There are good plans in the cooperation between academia and industry, such as Lectures for master students given by professionals from the industry. The collaboration with industry is closely traced in the UoA. Cooperation has been made with cyber security companies to provide scholarships for the best master students at cyber security study program. A number of projects and agreements are running with industry and research institutes which are at a high level. The UoA owns the infrastructure that is needed to conduct research at a sufficiently high level of excellence. The plans for its development are clearly explained, based on which it is possible to understand how Vilnius Tech sees itself in Lithuania and abroad in the upcoming future. A highlight of this section is a convincing and focused description of the R&D themes to be developed, which nicely allocates resources to the ambitious goals of the Unit. Nonetheless, the text lacks details about the possibility of accessing the infrastructure in the open mode.

The largest share of the employees is the group 35-44 years old, which should enable the continuation of the Unit development and realization of its strategic plan. The approach selected for the management of human resources is convincing. There are plenty of opportunities for young scientists, which are needed to keep the scientific activity of the Unit at a comparable level. A disadvantage is a lack of detailed analysis of the publication plans to enable evaluation of the ambitions of the UoA. The SWOT analysis is reasonable as it touches upon most expected aspect.

Apart from high recent investment in lab facilities, more effort should be recommended for motivation of young researchers into their PhD challenges, particularly in applied, innovative technologies.

Recommendations for continuity and/or improvement of the activities of the UoA

It is highly recommended to continue research activities, taking advantage of newly developed facilities and lab instruments, with specialized areas of applications (e.g., mechatronics and Structural Health Monitoring, innovative bio-medical technologies or Globe Health Monitoring with Artificial Intelligence involved in

interpretation of visions taken from satellites or from “Smart Space”). However, it is also recommended higher investment in START-UPS creation and SME activities in the area of innovative technologies applications, with quantifiable high TRL score, increasing positive economic and social impact of R&D. Financial support for establishing START-Ups and their activities gives at least 3 advantages: - strong motivation for young researchers, - increased university visibility, due to R&D outputs with high RTL parameters and anti “brain-drain” phenomena for the community of Lithuanian young researchers. Obviously, market-oriented activities initiated in Lithuania will play the role of very strong advantage, against eventual emigration to more developed technologically countries. The selected specialized areas of applications (mechatronics and innovative bio-medical technologies combined with Artificial Intelligence) became recently a very hot, global, technological challenge.

Other, general recommendations for continuity and/or improvement of activities are the following:

- Top journals and high-ranked conferences as the main target to improve the UoA visibility.
- Closer Integration with the international R&D community (joint projects, conferences, seminars – also via the Internet).
- More activities focused on EU R&D projects (e.g., Horizon programme).
- Further improvement of the PhD studies, including new initiatives animating young researchers (e.g., competition for demonstrators of innovative mechatronic devices).
- Continuous actualization of the research plans, especially in the situation, when dynamical development of the AI (Artificial Intelligence) concepts can be effectively incorporated into various mechatronic applications. It is highly recommended to continue research activities, taking advantage of newly developed facilities and lab instruments, with specialized areas of applications (e.g., mechatronics and Structural Health Monitoring, innovative bio-medical technologies or Globe Health Monitoring with Artificial Intelligence involved in interpretation of visions taken from satellites or from the “Smart Space”). However, it is also recommended higher investment in START-UPS creation and SME activities in the area of innovative technologies applications, with quantifiable high TRL score, increasing positive economic and social impact of R&D.

2.5. VU_MIF Unit of Assessment

Name of the institution	Vilnius University
Official abbreviation of the name of the institution	VU
Name of the Institution's unit of assessment (hereinafter – UoA)	Mathematics and Informatics
Abbreviation of the UoA name	VU_MIF
The scope of the UoA (FTE(SD))	90,58
Research area(s)	N 000 - Natural sciences, T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Natural sciences

Research field	Scope (FTE(SD))	Score (points)
N 001 - Mathematics	38,56	4

Reasoned justification of the score

The Mathematics field of the UoA includes a large number of researchers, working on several topics; some of them are well established, such as analytic number theory, partial differential equations, risk theory, optimization, others are rapidly growing. The research and teaching positions are rather equally distributed among senior and junior positions.

Excellent research is done in basic mathematics, mathematical techniques, and more applied studies. The research is carried out at a high level and internationally recognised. Special highlights include monographs in multidimensional optimization and multiscale modelling as well as articles in high-quality journals such as Applied Mathematics and Computation, IEEE Transactions Unreliability, Mathematics of Computation. Notable topics include economic forecasting, Navier-Stokes equation, zeta functions, and geometry. The best outputs are at an excellent level. The list of best contributions at international conferences includes a plenary talk, invited talks and an honourable mention paper. However, the overall output level is relatively low considering the large group although the rate of completion of PhD theses is very good. The number of notable papers per researcher is moderate. Some young researchers have fast-growing citation counts. The doctoral school has a good number of students. The number of completed PhD varies in the last years between 1 and 7, possibly due also to the pandemic as the enrolments and pipeline of students are at a good level around 10. Data on doctoral studies show relatively constant number of PhD students, and a very low number of students from abroad. All students are full-time, which is important for achieving research excellence and reflected in the good completion rate. The teaching staff with a scientific degree outnumbers the researchers. A weakness is the limited contribution of researchers from abroad.

Several competition-based projects have good outcomes. International collaboration is good, and this type of activity should be maintained and perhaps increased. However, in the last 5 years, the area of research has not been supported by international grants.

The list of the main national and international awards received for R&D demonstrates high recognition (mostly on the national level) of scientific and research contributions, both on the senior as well as junior levels. The unit is strong at the international level.

The computing facilities are very good: the UoA provides access to modern High-Performance Computing resources; UoA has the largest supercomputer in Lithuania.

Research field	Scope (FTE(SD))	Score (points)
N 009 - Informatics	40,35	4

Reasoned justification of the score

The UoA's Informatics research field is strong at the international level in informatics, as the research is of a high level and internationally recognized.

The research field of Informatics is a large group (40 FTE(SD)s). The distribution across senior and junior positions for both researchers and teaching staff follows the expected proportions of having fewer senior positions, but with a high number of lecturers. The output of PhDs per year in 2018–2022 was between 3 and 5, while students across the first, second, third, and fourth years are higher, possibly indicating dropouts. There could be more international researchers as well as international doctoral students.

Informatics research has many themes including expert systems, security, mathematics of computation, optimization, information theory, operation research, logics, cheminformatics, biomedical signal processing. Research outputs include monographs, and papers in important and high-impact journals of computer science, (Expert systems with applications, Journal of cheminformatics, IEEE transactions on information theory, ACM transactions on mathematical software). There are some recurring authors (Žilinskas, A.) so that the outputs could be better spread across groups. Some of the research highlights include a monograph on Bayesian and high-dimensional optimization (Zhigljavsky, A., Žilinskas, A., 2021) which is a very good sign of the vitality of the research. High-quality research is performed in multiple areas of informatics. Some of the papers have received very good traction through citations (e.g., 2020 paper "Globally-biased BIRECT algorithm with local accelerators for expensive global optimization", as well as in cybersecurity, 2020 the paper "A framework for competence development and assessment in hybrid cybersecurity exercises"). Papers are published in very good journals (Transactions of IEEE or ACM).

The reports presented at international conferences include keynotes speeches, some of the conferences or events are not the most prominent or competitive, and this could be improved. The list of the main national and international awards received for R&D demonstrates recognition of several achievements mostly on the national level, notable is the international award for European Commission's best structural partnership project. The competition-based R&D projects are international including a mix of national and international funding agencies including Baltics research program, EU Horizon 2020, Nordplus, three European Union Structural Funds, and an Erasmus+ funding. Some of the international collaboration is with prominent Universities such as KTH Royal Institute of Technology, Sweden. The national projects mostly funded by the Research Council of Lithuania include 4 Researcher Groups projects, 2 COVID related projects, as well as funds for Targeted attraction of foreign researchers, and a Postdoctoral Fellowships funded.

Despite the very good research, the international attractiveness of the field is still low, looking at the number of foreign PhD students; on the contrary, the number of national students is good.

Technology

Research field	Scope (FTE(SD))	Score (points)
T 007 - Informatics Engineering	11,67	3

Reasoned justification of the score

The field of Informatics Engineering is relatively small in terms of participating researchers and corresponding FTE. Its members are active in many areas of research, including cybersecurity, vessel navigation, machine learning, risk management and language technologies. The border between the fields of Informatics and Informatics Engineering is not clear. Some of the leading researchers (G. Dzemyda, A. Žilinskas, R. Paulavičius) appear in both fields. The research carried out by the field is of high level. The international cooperation and recognition are rather limited.

The field has a PhD program. In the years 2018-2022, 14 students defended their theses. One half of the theses were written in English, the second half in Lithuanian. The number of PhD students has a decreasing tendency, during the evaluated period the total number of PhD students fell by half (24 in 2018, 12 in 2022). The number of foreign students was very limited.

The list of the best research outputs includes a monograph published in Springer about Bayesian and high-dimensional global optimization (the monograph was shared with the field of Informatics, where it thematically belongs more). Other outputs were research papers published in good international journals. Two of the papers were devoted to important questions concerning blockchain technologies, other papers studied vessel navigation and effective quality of education. Many of the best research papers were also shared with other fields.

The list of the best reports delivered at conferences abroad shows a number of contributions at some well-known conferences, including IEEE conferences; however, there is a lack of invited or keynote talks. The list of awards received for R&D demonstrates recognition of scientific and research achievements on the national level. International awards were not received.

The members of the field were working on several projects devoted to cybersecurity, blockchain technologies, speech recognition, multidimensional scaling and education. Most of the projects were local, funded by Research Council of Lithuania, except for two Erasmus+ projects.

Economic and social impact of R&D activities of the UoA

Score (points)
4

Reasoned justification of the score

The UoA carries out highly significant scientific research and is a valuable partner in R&D beyond the academic community: business, decision makers and other actors in Lithuania. The research is thus important for society.

The main impact of the UoA comes from the teaching of students and from the knowhow from cutting-edge research. This education and knowhow of people leaving the university or collaborating with actors in the society is fundamentally important for Lithuania. It is also very important within the university as the knowhow generated by the research at the UoA has an important impact on other researchers in the university.

High-quality research training is offered to a large number of PhD students in an environment that is excellent in abstract as well as applied mathematics, informatics, and computer science, with a wide range of applications from probability and estimation theory to computational algorithms, to biology, medicine and technology.

Editorial board memberships in scientific journals show that some of the involved scientists are highly regarded. Several specialized journals are published by the university. Members of the Unit serve in various governmental and non-governmental committees.

Scientific events have been organized by the UoA. The most important conferences (in informatics, probability and statistics, number theory and biomathematics) and events organized by the UoA demonstrate a broad range of interest.

Consultation by the UoA has been provided to public and economic entities on teaching methods, AI in health, cyber security for state institutions and bodies and R&D project proposals for various companies.

The UoA has developed an Information System for Integrated Lithuanian Language and Writing Resources. It has collaborated with CERN and EuroHPC; it has established the Centre of Excellence for Analysis, Modelling and Risk Management, which contributes to improving the efficiency of tax administration. Other outputs include open-source software, work for and with the industry, and engagement with the European Open Science Cloud (EOSC) Nordic. The UoA has also performed COVID-related studies at the time of the crisis. A large socioeconomic impact comes from projects such as LIEPA 2, Rastija 2 (related to NLP technologies), Elsis Pro (air transport). Also notable is the UoA's project with UAB Girteka Logistics.

Research on education (including European collaboration) has been productive, including the monograph Measurable Education Effectiveness and Productivity (Vilnius University Press).

The UoA has a strong track record in science popularization, particularly through TEDx, Spaceship Earth festival, TV projects, and public lectures. They aim is to inspire young people to pursue science careers and educate gifted children through various media channels.

UoA researchers participate in various state and private entities, including National cybersecurity board, NATO Science, Lithuanian Academy of Sciences, and European Investment Bank. They also chair the Division of Technical Sciences in the Lithuanian Academy of Sciences and belong to international associations.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA possesses great potential for further development, owing to its strong R&D activities, excellent infrastructure, international collaborations, experienced professors, motivated PhD students and researchers, and effective organizational practices. The quality of its doctoral schools and the recruitment of talented students, including from abroad, are crucial for its future growth. These well-established doctoral schools in three fields serve as an excellent basis for new developments and expanded research and development activities.

The research staff consists of experts who publish in prestigious journals, actively engage in international collaborations, and hold esteemed editorial positions. The university successfully attracts some of the best students from Lithuania, ensuring a skilled talent pool for the UoA. The infrastructure, including the largest

supercomputer in Lithuania, along with other facilities including the library, provides strong support for future advancements. Additionally, fully funded PhD positions and scholarships, including unique state funding in mathematics, further contribute to maintaining and improving the university's performance.

The university's SWOT analysis provides a realistic and sensible assessment, assisting in suggesting and implementing measures for improvement. Its human resources management principles, covering recruitment, promotion, and work organization, align with global standards and similar institutions worldwide. The high quality of the research staff forms a solid starting point for further advancements. Another important aspect is the potential for enhanced research and development activities through the strengthening of existing national and international collaborations, as well as the establishment of new partnerships. The university's organization of multiple international conferences plays a vital role in broadening collaboration opportunities, allowing for the invitation of top scientists in relevant fields to visit Vilnius, fostering long-term relationships and international collaboration networks.

The proposed action plan is reasonable, with sensible descriptions and justifications of the R&D themes to be developed. The university's policy for training the new generation of researchers is well-conceived and aligned with best practices observed elsewhere. Ensuring an attractive environment for young talents to study and conduct research is of key importance. Moreover, the university already demonstrates success in attracting top students from Lithuania for bachelor studies, ensuring the continuity of research topics.

In terms of specialization, the university plans to leverage its researchers' expertise in Informatics, concentrating on important fields such as artificial intelligence, cyber security, and computational science. In Mathematics, the focus will be on research areas including number theory, probability and statistics, and partial differential equations. With these strategic directions, the university has the potential to achieve highly favourable ratings in the coming years, leading up to the next evaluation.

Recommendations for continuity and/or improvement of the activities of the UoA

More prestigious journals could be targeted in cases where major new findings or other progress has been made in the research. The UoA or the University should develop incentives to publish the best research results in the most prestigious international journals. Likewise, incentives must be developed for participation and publication of results in the very best conferences, especially in Informatics.

Monetary incentives should be established to motivate improvement and resubmission of ERC proposals that have been evaluated and passed to the second or interview stage but not funded.

A strong effort is recommended to keep and even improve the competitive level of the infrastructure.

To counter the reduced student interest in math and smaller age groups, decisive measures are required:

- 1) enhance the appeal of UoA studies,
- 2) generate interest in STEM subjects among high school students through joint campaigns with other universities in high schools*,
- 3) secure more national and international funding,
- 4) attract international top talent to study, work, or collaborate within the Unit, for example, through European research programs or other international partnerships,
- 5) increase in the proportion of women entering the UoA,

6) aim for a more ambitious action plan regarding international integration, collaboration, exchanges, and projects, and expand opportunities for collaboration with industry. Participating in larger, international competitive calls is highly recommended.

Due to the current rapid progress in AI and machine learning, R&D plans will need further revisions/updates in the mid-term future (e.g., related to developments of Large Language models and foundation models).

The UoA must increase ambition levels and set specific, measurable goals. Success should come from leveraging unique strengths, focusing on promising research areas, while remaining open to new approaches. Encourage students to propose new ideas and bolster the start-up culture. Increase the attractiveness of summer schools and events to draw in foreign participants and promote the university.

* An excellent example of improving high-school students' interest in math comes from Israel, where academic volunteers participated in a "marketing campaign", visiting schools and informing students about STEM at universities:

<https://www.taubcenter.org.il/en/research/raising-the-bar-are-enough-israeli-students-taking-advanced-math-and-english/>

3. FINDINGS

Findings of the Panel VV_GR_NT_2 are described below under five subtitles: (i) The overall quality of research and its level of internationalization, (ii) Knowledge transfer, (iii) Infrastructure, funding, management, human resources, (iv) Recommendations for the covered research fields, and (v) Recommendations for the national science system.

The overall quality of research and its level of internationalization

The Units visited by the Panel have shown improvement in the overall quality of research, a positive trend that extends across all of them. Particularly encouraging is the significant increase in international collaborations, both in terms of quantity and, importantly, in the quality of these partnerships. To continue this positive trend, there is a call for increased ambition at every level of research, be it research units, groups, or individual researchers. Defining clear and well-thought-out strategies and plans for achieving excellence should be the priority. Aiming for the best possible journals and conferences when disseminating results will elevate the reputation and impact of the research endeavors.

An area that requires attention is the focus on publication quality over quantity. The emphasis should be on improving the quality of publications by submitting to journals and conferences that make a significant impact in the field. Invited and plenary contributions in top conferences are an indication of a globally recognized research unit.

Furthermore, the positive trend of research groups to expand their networks beyond Lithuania and close-by countries should be continued. The maturity level of the research units is sufficient to take more often leading roles in such consortia. By actively engaging with institutions across the European Union and elsewhere, the Units can foster more extensive collaborations, exchange knowledge, and share resources. Despite the active acquisition of joint funding, there seems to be in many cases a low fraction of joint publications reflecting these collaborative efforts. Encouraging and facilitating coordinator positions of consortia will not only strengthen the research outcomes but will also lead to an important benchmark of internationally high-quality research and related impact.

Knowledge transfer

The visited Units have demonstrated success in engaging with local industries and effectively transferring knowledge, resulting in valuable contributions to society. The Panel was impressed by numerous instances where their research achievements evolved into commercial products or advanced prototypes, showcasing the tangible impact of their work. It is essential for the management of these Units to continue supporting and nurturing this positive trend.

Each Unit has made dedicated investments in leveraging their resources to enhance the socio-economic impact of their research activities. This commitment to maximizing societal benefits should remain a key focus and be further strengthened with consideration of future needs. As a specific example, one crucial aspect that warrants attention is the exploitation of Intellectual Property (IP), particularly when collaborating with industries and leading research groups within universities.

Infrastructure, funding, management, human resources

The research infrastructure has proven to be of very good quality, providing adequate support for conducting high-level research. Both funding and management practices are well-aligned to facilitate the research initiatives. However, in terms of career development and human resource management, there are certain

areas that warrant attention. One notable concern is the high teaching load experienced by several researchers, especially in undergraduate studies. This heavy workload can sometimes hinder the ability to engage in high-level research. Finding a balance between teaching responsibilities and research pursuits is essential to foster a thriving research environment.

While there has been progress in achieving a better gender balance compared to the past, it remains crucial to continually monitor and strive for further improvements in this area. Creating an inclusive and diverse research community is not only a matter of fairness but also enhances creativity, innovation, and overall research productivity.

Currently, a significant proportion of PhD students have graduated from the same university and subsequently continue their careers as researchers within the same institution. To promote greater diversity of ideas and approaches, there is a need to prioritize mobility. This can be achieved by actively hiring more international researchers, PhD students, postdocs, and professors. Encouraging and facilitating long-term research periods abroad for locally originated researchers should become a standard practice for career development. Such experiences abroad can enrich researchers' perspectives, broaden their networks, and foster collaboration with researchers from different cultural backgrounds.

Recommendations for the covered research fields

The Panel recommends implementing a comprehensive system of incentives at the level of individual researchers and research groups to foster excellence in research, publications, conference presentations, and grant applications, with a particular focus on prestigious European grants like the ERC. To support researchers in achieving these goals, organizing training in grant writing and research project planning would be instrumental. Additionally, incentivizing individuals to take initiative and assume coordination roles in international grants will not only advance research collaborations but also elevates the institution's reputation on the global stage.

In the pursuit of effective knowledge transfer, the Panel emphasizes the need for more systematic outreach activities, nurturing an environment conducive to innovation and economic impact. Establishing dedicated support mechanisms for start-ups arising from research results would further bridge the gap between academia and the entrepreneurial world.

To strengthen the research ecosystem, specific attention should be given to certain aspects. Balancing teaching loads, especially concerning undergraduate studies, is essential to ensure that researchers can allocate ample time and energy to high-level research endeavors. Enhancing gender balance within research units is a priority, as diverse perspectives lead to more comprehensive and innovative solutions. Promoting mobility is equally crucial for fostering a dynamic research environment. To achieve this, efforts should be made to increase the share of PhD students coming from abroad and other Lithuanian universities. Leveraging the strength of doctoral schools across various research units and prioritizing their development in institutional plans would attract top talent and elevate research standards.

Investing in effective marketing of the institutes is needed to attract future students and researchers both locally and globally. Strengthening visibility in high schools, emphasizing the value of STEM subjects, would ignite interest in research and academia from an early stage. It would be beneficial identifying and recruiting the best and most motivated students for summer jobs after just one, two, or three years of study. Offering them opportunities to engage in meaningful research experiences and supporting their potential could encourage them to pursue their academic journeys, ultimately leading to the pursuit of a PhD and fostering a pipeline of passionate researchers.

Recommendations for the national science system

The assessment of universities research activities plays an important role in the national science system. To support further development of Lithuanian universities towards a globally leading level, also the assessment methods need to develop. A particular focus should be placed on refining the format and content of the written material submitted to the Expert Panels in order to allow the Units to demonstrate their excellence and the experts to collect this information in a straightforward way.

While the site visits offer an opportunity to highlight the key successes of the Units, it would be beneficial to include brief benchmarking information in a free format within the assessment documents as well. Moreover, to facilitate a comprehensive evaluation of research impact, the Units should provide bibliometric information according to the instructions by the organizer of the assessment. A specific figure of merit is provided by joint publications with international partner organizations resulting from various collaborations. Such improvements would not only enhance the credibility of the assessment process but also foster continuous improvement, ensuring that Lithuanian universities are well-positioned to thrive on the international stage.

