March 2021

International Evaluation of Scientific Institutions Activity

Panel Report: Natural Sciences

Professor Mats Gyllenberg (Chairman), Professor Frank Behrendt, Professor Maria Kaminska, Professor Brian Foster, Professor Milena Horvart, Professor Andras Baldi

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Table of Contents

Figures

1 Introduction

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

The Natural Sciences panel evaluated seven institutions:

- Latvian Institute of Aquatic Ecology, Daugavpils University
- Institute of Solid State Physics, University of Latvia
- Latvian State Institute of Wood Chemistry
- Research programme "Biology", Daugavpils University
- Cluster of Natural Sciences, University of Latvia
- Ventspils University of Applied Sciences Natural Sciences Research Platform
- Research programme "Mathematics, Physics, Chemistry", Daugavpils University

The Panel evaluated the institutions using the following criteria:

- Quality of the research
- Impact on the scientific discipline
- Economic impact
- Social impact
- Research environment and infrastructure
- Development potential

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

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

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

The analysis of each institution by the Panel is presented in the following sections.

Feedback on Panel assessment received from the institutions is published in the **Error! Reference source not found.**. The Panel has reviewed the feedback and decided to make few small changes.

2 Institution reports

N_1 Latvian Institute of Aquatic Ecology, Daugavpils University

2.1 Institute Data and Description

The Latvian Institute of Aquatic Ecology (LIAE) is a research institute investigating marine and freshwater environmental processes. At the heart of all LIAE's activities is the aim to achieve a healthy and functioning aquatic environment in Latvia. LIAE is currently an Agency of Daugavpils University with approx. 45 staff members and yearly assets around € 1m.

LIAE's main research directions include long-term dynamics of marine ecosystems, biogeochemical processes in water and sediments, marine biodiversity and ecology of non-indigenous species, ecotoxicological properties and ecosystem health assessment, ecosystem approach in maritime spatial planning and involvement in novel use of marine resources. LIAE is also responsible for running the national marine monitoring programme.

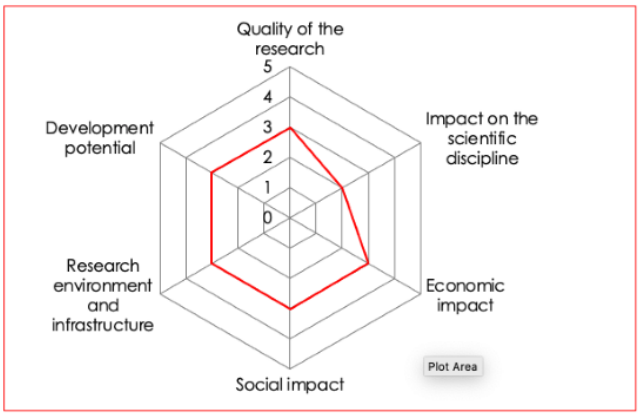
Latvian Institute of Aquatic Ecology	
Primary field of research	i) Earth and related environmental sciences, ii) Biological sciences
Number of academic personnel	-
No. FTE academic research personnel 2018	27.1
Total number of FTE academic and research personnel 2018	27
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	43
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	2
Monographs in period 2013-2018	0
Patents Latvian in period 2013-2018	0
Total no. of self-reported outputs in period 2013-2018	45
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	1.33
No. of all outputs in period 2018 per researcher in 2018	1.39
No of PhDs completed in period 2013-2018	3
No. of PhDs in period 2013-2018 per researcher in 2018	0.10
Total funding in period 2013 -2018 (Euros)	€ 6,419,697
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 236,889

2.2 Expert panel evaluation

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

Figure 1 Latvian Institute of Aquatic Ecology– Scores

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



Overall score

Score: 3 - good

In summary, the institute is a strong national player in the field of applied science and has extended this position to a wider stable position in the Baltic region. The institute is well integrated and capable of implementing complex measurements to monitor the state of the marine environment. The institute has developed towards meeting the national and international needs and intends to build a stronger research base in the future. More efforts are needed to develop a stronger and more ambitious strategic research plan. In this respect, LIAE needs to align its research program with a well-structured graduate and postgraduate degree at the host university, which will attract national and international academic staff and students. In terms of dissemination of the scientific results, a modest number of scientific publications with no substantial increase over the evaluation period is noted. The panel acknowledges the fact that the publications appear in reasonably good international journals, so quality obviously prevails quantity. Apart from scientific publications and presentations at national and international events, the institute organised several events and proved to be very active in the larger geographical Europe. Communication activities at the national level are also well noted, although the web site needs to be amended and further developed to be better accessible for a broader audience and in particular the user community. Moreover, the communication strategy and outreach to the general public is still to be further developed. Direct collaboration with industry is limited, however the indirect economic impact of LIAE for Latvia and the wider Baltic region contributing to a sustainable usability of the Baltic Sea is well documented. A good example is the implementation of the Ballast Water Convention as an important component for maintaining a good water quality needed by the fishing sector. A modern building, laboratories and especially equipment are available to undertake very good research activities. With respect to this, the institute has made good use of its solid base funding stemming mainly from European infrastructure programmes. Its research infrastructure allows LIAE to implement competitive research at national and international level, but their potential has not been fully utilised as yet. Strong networking and integration in European and global earth observation initiatives is therefore strongly recommended. Moreover, a postgraduate programme in which LIAE staff could pass on its experience to younger generations and attract excellent experts and students from abroad would increase its internationality.

Quality of Research

Score: 3 - good

The research performance can be described as good based on the research output during the last six years. The panel notes that the institution is strongly oriented towards applied

science. It is responsible for the implementation of marine monitoring programmes, covering biological and chemical measurements followed by data interpretation and reporting.

The priority areas in marine science are well covered and include eutrophication, maritime spatial planning and ecosystem approach, marine biodiversity, and marine pollution issues. The institution has built a very strong capability to produce comparable and much needed data related to the state of the marine environment. Obtaining comparable data in space and time requires skilled and motivated staff, infrastructure as well as stable funding. These elements including formal accreditation are in place. This obviously takes a large proportion of time from the researchers, leaving less time for basic research. Nonetheless, the researchers have put efforts in turning these high-quality data into publications. Although the number of these publications is rather modest, these seem to be well recognised at the national, regional and international level.

The Panel recognises that the staff is involved in graduate and postgraduate studies, however, lack of alignment of their expertise with a well-structured programme related to marine studies is a weakness also reflected by a relatively small number of master and PhD students.

The institution is adequately integrated internationally into regional research activities, especially in the Baltic area. In terms of EU framework programmes the institution is insufficiently active. In summary, the Panel is of the opinion that the institution is a strong national player, well integrated and capable of implementing complex measurements to monitor the state of the marine environment. The Panel also recognises that the scope of research at LIAE can be extended, strengthened and more strongly linked to international research priorities.

Impact on the scientific discipline

Score: 2 – adequate

The Panel recognises the very applied nature of the research performed at the LIAE which consequently resulted in a modest number of scientific publications with no substantial increase over the period from 2013 to 2018. The publications appear in reasonably good international journals and the list of publications involves a serious proportion of LIAE's researchers. Apart from scientific publications and presentations at national and international events, LIAE's groups organised several events and proved to be very active in the larger geographical Europe.

The LIAE as a research entity is attached to Daugavpils University and offers bachelor, master and PhD research topics to students of this university. While a good number of doctoral students has been enrolled during the reporting period, only three defended their dissertation and a total of 12 completed master degrees are listed. The Panel is of the opinion that effective alignment of the LIAE research program with a well-structured graduate and postgraduate degree program at the university would enhance national and international visibility and consequently increase the impact of their research activity.

Economic impact

Score: 3 - good

The Panel recognizes that LIAE has aligned its activities towards national and international needs to better understand the state of the marine environment, leading to strong interactions with policy makers, the public sector and the public at large. While interactions with industry and the private sector have been limited, the Panel acknowledges the indirect economic impact of LIAE for Latvia and the wider Baltic region by contributing to a sustainable usability of the Baltic Sea. A good example is the implementation of the Ballast Water Convention as an important component for maintaining good water quality needed by the fishing sector.

Social impact

Score: 3 - good

The Panel recognises a strong collaboration with the public sector (as noted in the previous section). While strong outreach and communication activities have been reported, the effectiveness of these activities is not sufficiently substantiated. Quantitative information on the number of events, people reached, visits to its website, and attendees at various events is not fully available. The website is pretty conventional and it is difficult to find information on services, activities, highlights, which would make the LIAE more visible to graduate students and the public at large. The Panel is of the opinion that the communication strategy and outreach to the general public needs to be further developed.

Research environment and infrastructure

Score: 3 -good

LIAE is an agency at Daugavpils University, which seems to be the best organisational set up for the type of applied work performed by this institution. Being strong in monitoring activities supported by formal accreditation, the LIAE quality management must be very well organised, though the self-evaluation report is not explicit about this. Moreover, information on the website is also not sufficiently clear on how the LIAE is internally organised and what are the formal agreements and interactions with other programmes, organisations and networks (other than project based). This should be improved in the future.

A modern building, laboratories and especially equipment are available to undertake very good research activities. With respect to this, the institute has made good use of its solid base funding stemming mainly from European infrastructure programmes. Its research infrastructure allows LIAE to implement competitive research at national and international level.

A potential for an open access to the research results has not been fully developed as yet and the Panel is of the opinion that this should be included in one of the research priorities of the strategic goals at national and international level. Strong networking and integration in European and global earth observation initiatives is therefore strongly recommended.

Development potential

Score: 3 – good

It is laudable that the LIAE has developed and implements a coherent future development plan going beyond the framework of Daugavpils University. It is to be expected that the LIAE will continue its role as an important scientific player at the national as well as international level in the field of sustainable marine systems in the future. An important part of this should be the extension of the current mainly applied research portfolio by more fundamental aspects.

Opportunities are correctly identified as part of the SWOT analysis and development-potential chapters in the self-evaluation report. The institute demonstrates its willingness to further develop research directions, to attract students, and to act on thematic project calls. However, the means by which this should be achieved are not described specific enough. Similar goals were set in the previous evaluation and some progress can be stated, but there is still room for further progress. The research strategy should be more concrete, including more ambitious and quantitative specific goals (e.g., the number of papers in best journals, number of master and PhD theses, number of post-doc positions, etc.). Without quantitative goals it is not possible to evaluate the progress and effectiveness of the measures aiming at increasing the quality of the research.

Different to many other Latvian research entities LIAE already has a substantial national base and infrastructure funding making it a bit less vulnerable to decreasing EU funds. Nevertheless, the continuously needed funding for infrastructure and research equipment will need a

continued and growing funding level from national resources. Given the importance of the Baltic Sea to Latvia such growth in funding is highly recommended.

Also important for a further positive development will be an effort to maintain the currently balanced age structure of its personnel. The measures described in the self-report to positively develop its personnel are very structured and likely to succeed.

The LIAE has taken the recommendations from the last evaluation seriously by developing and partially implementing steps showing a clear pathway and potential to maintain and even expand its role in the foreseeable future.

Potential to offer doctoral studies

At the postgraduate level LIAE staff is primarily involved in the supervision of ongoing thesis work and membership in PhD examination committees. Integration of LIAE's research topics into regular graduate or postgraduate study programs at Daugavpils University has not yet been achieved, which is a weakness that should be urgently addressed. Although there seems to be an increase in the number of PhDs in recent years and measures to attract students are provided, sustainable growth can only effectively be assured if the LIAE staff members themselves have stronger academic positions and/or are well-integrated into the university programmes. This would, among others, maximise the potential of the infrastructure.

Alignment with Smart Specialisation Strategy

There is significant LIAE alignment with the Smart Specialisation Strategy contributing to knowledge-intensive bioeconomy. LIAE seriously considers the necessity of knowledge-intensive bioeconomy being not only profitable but also sustainable and emphasises a novel use of available resources. Challenges for knowledge-intensive blue bioeconomy, sustainable mariculture, and sustainable growth of macroalgae in the Baltic Sea region are addressed. These also contribute to the promotion of circular economy and create new business opportunities. Moreover, the use of beach-cast macroalgae for product creation and inclusion of ecosystem approach, when creating maritime spatial plans, are other solutions for gradual and sustainable development of smart blue bioeconomy. LIAE also contributed to the preparation of the national bioeconomy strategy at the drafting stage. Panel is of the opinion that LIAE is well aligned with Smart Specialisation Strategy in Latvia.

Conformity with state scientific and technology development

LIAE is a leading national institute in the field of marine ecosystems. LIAE is well integrated in regional and international networks, policy frameworks (HELCOM, ICES) and research communities at large. It compliments and collaborates rather than competes with institutes in similar areas of research at the national level and the Baltic Region. LIAE has a great potential in providing training in research that can promote priority areas, particularly related to blue economies. In order to take advantage of the unique expertise of the LIAE and create the conditions for long-term work in the field of marine ecosystems, it would be necessary to set up and promote both an undergraduate and postgraduate programme in which LIAE staff could pass on experience to younger generations. This should be consolidated as a national and international programme, thus attracting excellent experts and students from abroad and increasing its internationality.

Recommendations

- The research vision and strategy need to be extended to go beyond the currently strong applied research portfolio and include strong fundamental aspects of research.
- Leadership and operational management seem to be in place, however, the information provided is not fully clear and should be provided on website (and to future evaluations).
- Research strategy needs to elaborate policy on open access to research results.

- In terms of research staff LIAE needs to increase the number of academic staff, both national and international, and to open up for postdoctoral visitors.
- Excellent research infrastructure available at LIAE should become more visible and better accessible for national and international research co-operations.
- Current research collaborations are impressive, however LIAE staff should increasingly take the leading role in international collaborations; more initiatives should be explored in particular in EU-wide schemes.
- Collaborations within Latvia have been documented and their principle is to cooperate rather than to compete. There is still room to explore further possibilities for strengthening interdisciplinary research both nationally and internationally by sharing equipment, support services, and unique expertise.
- Although a substantial part of funding for the implementation of national needs is secured, there are a lot of opportunities to increase international funding, particularly from competitive calls and the institution should be more proactive in pursuing these funding routes.
- It is highly recommended to develop a doctoral training programme or to become more strongly involved in a doctoral programme within Latvia and preferably to establish an international doctoral programme in marine sciences for Latvia and universities in the Baltic region.

N_2 Institute of Solid State Physics

2.3 Institute Data and Description

The Institute of Solid State Physics, University of Latvia (ISSP) is a research institute established in 1978 to conduct research in the areas of condensed matter physics and materials sciences. ISSP is an independent legal entity founded by the University of Latvia with around 230 employees and a turnover of €9.76m in 2018.

The main research directions of ISSP are:

- Theoretical and experimental studies of materials structure and properties;
- Nanotechnology, thin films, nanomaterials, and ceramics;
- Functional materials for photonics, sensorics, and electronics;
- Materials for energy harvesting and storage.

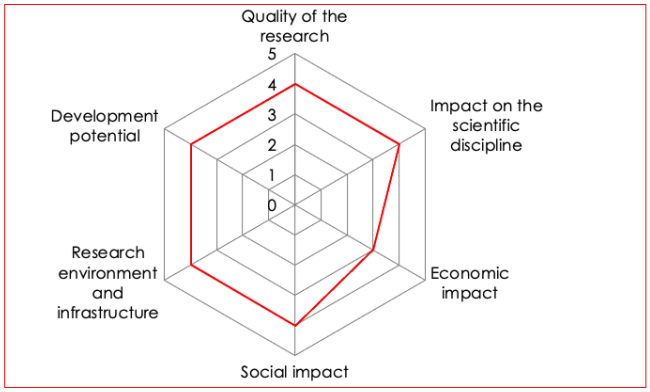
Institute of Solid State Physics	
Primary field of research	i) Physical sciences, ii) Materials engineering, iii) Nanotechnology
No. FTE academic personnel 2018	-
No. FTE academic research personnel 2018	93.2
Total number of FTE academic and research personnel 2018	93.2
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	713
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	65
Monographs in period 2013-2018	0
Patents Latvian in period 2013-2018	6
Patents (Europe and international) in period 2013-2018	8
Total no. of self-reported outputs in period 2013-2018	792
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	5.01
No. of all outputs in period 2018 per researcher in 2018	5.57
No of PhDs completed in period 2013-2018	19
No. of PhDs in period 2013-2018 per researcher in 2018	0.14
Total funding in period 2013 -2018 (Euros)	€ 26,384,700
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 283,098

2.4 Expert panel evaluation

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

Figure 2 Institute of Solid State Physics – Scores

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



Overall score

Score: 4 – very good

The technical infrastructure of The Institute of Solid State Physics (ISSP) has improved greatly since the last review. It has a strong research programme in condensed-matter physics, materials and devices, and contributed flexibly to the recent development of Covid-19-related research topics. It has a very good record of publications, some in high-quality journals. It interacts well with Latvian industry, within the limits of the scale and scope of the Latvian industrial landscape. It has some imminent challenges to face in terms of the structure of its workforce. It has a strong programme and appropriate structures for future planning, giving it good development potential. The programme and current research activity align well with government policies and Latvian strategic directions of development. It has a good and innovative programme of public engagement, which should be continued and expanded.

Quality of Research

Score: 4 – very good

ISSP is the national leader, and a leader in the Baltic States, in the field of condensed-matter physics, materials science and associated interdisciplinary research. This is reflected in the scientific outputs reviewed, which were of high quality, with only one output of somewhat lower standard. The institute scientific achievements are comparable to thematically similar institutes worldwide. The main directions of research (technology, theoretical modelling and experimental studies of materials for photonics, sensors, electronics, and energy harvesting and storage) are widely recognised as presently important in materials science and are in line with EC and national priorities in research. The bibliometric indicators are good, although not outstanding, even among the other institutions being evaluated by this panel. The self-evaluation document shows a clear understanding of the core activities of the institute and what is required to promote them. Good use is made of large international research infrastructures, particularly those in Hamburg. The panel was impressed by the quick reactions of the institute in expanding already existing lines of research and starting new ones in response to the Covid-19 pandemic. Overall, this is a very creditable performance.

Impact on the scientific discipline

Score: 4 – very good

Strong international recognition of ISSP was demonstrated in 2017, when it became the first research organisation in Baltic Sea region to receive second phase funding for implementation of CAMART2 "Excellence Centre of Advanced Material Research and Technology Transfer". The publication record of ISSP in peer-reviewed journals is good, some in journals with high impact factor, although there is considerable room for improvement here. High-profile papers

obtained from data taken at major international infrastructures are another indication of impact. The citation record of ISSP is good, although only slightly above the average of the other groups in this review. Although international cooperation is strengthened via EU-funded projects, the number of these is still relatively small compared to comparable institutions in Western Europe. Although an error was discovered in the statistics published in the self-assessment document, the number of exchange visits of students and scientists with foreign institutions is still relatively small.

Economic impact

Score: 3 –good

It is pleasing to note that, in connection with the CAMART programme and one of the three key goals in ISSP strategy, the institute has intensified work towards application-driven research and industry collaboration. This has resulted in e.g. new OLED emitter materials, new thin films for catalyst applications (collaboration with Schaeffler within CO2EXIDE H2020) and development of metallic Li deposition technology with the Sidrabe company. The Institute has created a special unit "Materize", responsible for collaboration with industry, which acts as a national hub, bringing industry and academia together for application of smart materials in photonics. The institute has some registered patents, none of them from the last three years of this evaluation. The visit resulted in the clarification that ISSP is re-examining its policy on patenting, restricting it to those with a high chance of being taken up by industry. The annual average of 12 industrial and 16 cooperation projects is welcome. It is encouraging to see the target of 1-2 MEuro from industry in the CAMART2 programme, compared to the current figure of ~ 0.5 MEuro through EU initiatives. Direct funding from contract work for industry is small. The three spin-out companies are welcome, but it seems that none have been established since 2013, so the "Deep Science Hackathon" initiative is timely. Although there are hopeful signs for future development, the current level of interaction with industry is modest for an institute of this type and capabilities. While Latvian hi-tech industry is relatively small, which clearly militates against strong industrial involvement, the Institute needs to intensify its efforts in this area, if necessary, looking outside Latvia for appropriate partners.

Social impact

Score: 4 – very good

The ISSP plays a major role in Latvia in education of students and collaborates with the Faculty of Physics, Mathematics and Optometry of the University of Latvia in educational activities. The involvement of ISSP staff in the development of new university courses and in teaching is to be commended. The ISSP interacts with school children via special lectures and visits of approximately 150 schoolchildren per year to the Institute from all around Latvia. It participates in actions like Researchers Night and gives interviews to the local press, radio and TV. Articles of general interest are also produced for the local media. Quantitative evidence on how positive such interactions are and on what scale and with what depth would strengthen the case. The fact that only two out of fifteen scientific departments or units are headed by women and a similar imbalance in senior researchers shows that there is potential for improvement in gender equality issues.

Research environment and infrastructure

Score: 4 – very good

It is very pleasing to note the very significant investment in particularly the clean rooms of the ISSP since the last review. Further improvements are planned in the coming years with CAMART2 funds. This means that the institute now has state-of-the-art facilities in which to carry out operations sensitive to environmental contamination, which are essential for world-leading research in this area. The panel was pleased to note the active International Scientific Advisory Board. These highly positive aspects are balanced by some challenges. The large number of very senior staff and the small number in the middle rank is a matter of concern. The large

fluctuations in staff numbers recorded in the self-assessment is inimical to a supportive and efficient research environment. Urgent action needs to be taken in terms of career prospects and progression both to recruit new young staff with an attractive career-progression path and more importantly high-quality mid-career researchers who will be able to provide future leadership. A strategy for attracting international students/post docs is needed. Appropriate opportunity to engage in university teaching and PhD supervision can play a role here. It does seem that the ISSP should have the capacity to take on a larger number of PhD students, since the ratio of PhD students to the total number of researchers is about ¼, which seems low for a university unit. The number of defended doctoral dissertations is smaller than is appropriate given the total number enrolled in doctoral studies. Although details in the self-assessment document are sketchy, there seems to be an adequate number of support staff for the Institute's needs. Financial planning is very important for the Institute, since the state base funding covers only about 18% of the total budget. Most of the financing comes from project money, which is a challenge. Increased base funding would provide a more stable platform from which ambitious new projects and concomitant funding could be launched. If these problems can be addressed, then the research environment will be excellent.

Development potential

Score: 4 – very good

The ISSP has substantial development potential. It is pleasing to note the doubling of the turnover of the institute since the last review. However, almost all of this comes from short-term grants, applications and contracts. An increase in the base funding of the institute would have very substantial benefits particularly in terms of career progression and attractiveness for recruiting new staff, essential for the future of the institute as indicated in the previous section. Its potential, thanks to high investment in infrastructure, should grow. The Institute is active and quite successful in raising funds that are awarded competitively. Actions regarding the enhancement of student and researcher exchange, or open positions for international researchers should be increased. This would enable ISSP to exploit the opportunity provided by the generation gap between the age groups of 40 to 60. In its SWOT analysis, ISSP realistically assesses its situation and has a carefully considered plan. This does not mean, however, that the implementation of this plan will be easy. The proposed actions to attract more students and strengthen cooperation with industry (including foreign ones) are appropriate. The scientific programme direction seems to be good and to play to the institute's strengths. Further use should be made of the advice of the International Scientific Advisory Board in exploiting the Institute's future potential. More interaction with industry would be an excellent development as would new initiatives to attract young people into science.

Potential to offer doctoral studies

Although not itself able to offer PhD studies, the close connection between the ISSP and other departments in the University of Latvia, principally Physics, means that it does play host to a considerable number of graduate students. The excellent facilities available at ISSP, the high standard of research and the availability of excellent supervisors mean that ISSP is an excellent host for many PhD students, who expressed considerable satisfaction with their experiences at ISSP. The ISSP is to be congratulated for the excellence of the PhD experience that it provides.

Alignment with Smart Specialisation Strategy

As clearly stated in the self-assessment report, the research topics of ISSP align with 3rd Smart Specialisation Area of RIS3 of Latvia which is "Smart materials, technology and engineering systems" and the European Commission defined KETs – Advanced Materials, Photonics, Nanotechnology and Micro- and Nanoelectronics. The research, development and innovation activities at CAMART2 (thin films, nanomaterials, functional materials for electronics and photonics, modelling) contribute to achieving the objectives of the Third Specialisation in all three product developments, as defined in RIS3 document, which is, in brief: designing new smart materials, identifying materials for prototype product, providing engineering solutions for

manufacturing marketable products. The ISSP is the premier institution in Latvia working in the area of new materials and their applications and their research programme is very strong in these areas. To a lesser extent, there is also alignment to the fourth area, Smart Energetics.

Conformity with state scientific and technology development

ISSP contributes to the objectives of Latvia's scientific and technological development as defined in key policy documents (e.g. Science, Technological Development and Innovation Guidelines 2014-2020, Education Guidelines 2014-2020 and other). "Technologies, materials and systems engineering for increased added value products and processes, and cybersecurity" is one of nine science and research priorities defined in the legislation of the Republic of Latvia as the "Priority fields in science 2018-2021". There are three major priorities in innovation development: smart materials and photonics; smart city; biomedicine and precision medicine. The ISSP aligns strongly to the first two of these areas and to some extent to the third, via the work on antibacterial coatings. As remarked elsewhere, there is a good collaboration with industry, but it is at a relatively low volume, to a large extent conditioned by a lack of Latvian high-tech industries in the areas of ISSP's expertise. However, the panel was impressed by the positive statements at the panel visit from those industries that do collaborate with ISSP. More should be done to internationalise in particular the personnel of the institute, both research staff and students.

Recommendations

- The number of papers with international collaborators could be increased. The number is still relatively small compared to comparable institutions in Western Europe
- More papers should be published in high impact-factor journals
- Continue the excellent programme of research infrastructure improvement
- The number of exchange visits of students and scientists with foreign institutions is relatively small and should be increased
- The Institute needs to intensify its collaborations with industry, if necessary, looking outside Latvia for appropriate partners.
- Promote and support science-industry cooperation through dedicated grants with funds for both partners, so that ISSP could participate in such projects
- The large number of very senior staff and the small number in the middle rank is a matter of concern. Urgent action needs to be taken in terms of career prospects and progression both to recruit new young staff with an attractive career-progression path and more importantly high-quality mid-career researchers who will be able to provide future leadership. A strategy for attracting international students/post docs is needed.
- Improve the gender balance in senior positions
- Increase the number of PhD students, since the ratio of PhD students seems low
- Improve the completion rate for PhD studies
- Continue to engage the International Scientific Advisory Board in the ISSP's future planning
- Develop new initiatives to attract young people into science, ensuring that the success of such initiatives can be quantitatively measured by means of e.g. questionnaires, letters of support etc.
- Increase the base funding of the ISSP, which will provide a more stable platform from which ambitious new projects could be launched

N_3 Latvian State Institute of Wood Chemistry

2.5 Institute Data and Description

The Latvian State Institute of Wood Chemistry (LSIWC) was founded in 1946 to conduct research into wood and other plant biomass to support development of knowledge for sustainable utilisation of natural resources for economic, social and ecological benefits.

LSIWC is divided in 6 laboratories, which cover all the scientific areas of biomass components. LSIWC has 116 employees and in 2018 the institute's turnover was €3.4m. The main research directions are related to:

- Fundamental studies in the field of wood science, wood and polymers chemistry;
- Applied studies for obtaining innovative products and materials from renewable raw material resources – wood and plant biomass.

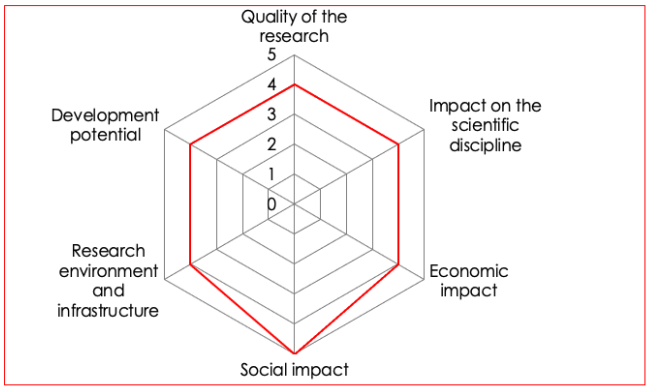
NAME OF THE RESEARCH UNIT	**Latvian State Institute of Wood Chemistry**
Primary field of research	i) Chemical sciences, ii) Chemical engineering, iii) Materials engineering
No. FTE academic personnel 2018	-
No. FTE academic research personnel 2018	65.2
Total number of FTE academic and research personnel 2018	65.2
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	260
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	168
Monographs in period 2013-2018	0
Patents Latvian in period 2013-2018	23
Patents (Europe and international) in period 2013-2018	11
Total no. of self-reported outputs in period 2013-2018	462
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	3.99
No. of all outputs in period 2018 per researcher in 2018	7.09
No of PhDs completed in period 2013-2018	17
No. of PhDs in period 2013-2018 per researcher in 2018	0.26
Total funding in period 2013 -2018 (Euros)	€ 15,427,495
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 236,618

2.6 Expert panel evaluation

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

Figure 3 Latvian State Institute of Wood Chemistry – Scores

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



Overall score

Score: 4 – very good

The Latvian State Institute of Wood Chemistry's (LSIWC) activities on processing of wood and creating products out of it are important for the Latvian economy. It clearly is able to live up to its strategic advisory role in the national economy with respect to this resource.

The Panel observes that the current status of the LSIWC in comparison with the one during the last review in 2013 is characterised by partial reorganisation and a re-focussing of the research activities. The development since then has to be described as sideways. The LSIWC's performance remains very good at both the national level as well as when compared with international competitors.

The LSIWC shows a good publication activity in good international journals which is well received as documented by the citation numbers. The annual number of publications remained constant at about 45, while the total number of citations increased steadily from 200 in 2012 to over 600 in 2018.

While there is a well-established collaboration with local and national wood-related industry, the projects tend to be financially limited in size. Given the amount of applied research, the small amount of patents surprises. The planning of the EU-funded pilot-plant hall, which is currently being completed, lacks coordination with the industrial partners. This may cause problems in bringing this investment into good use with the partners.

There is a significant interaction with the public creating a social impact of its research activities, but the quantitative description of these could be improved.

The LSIWC's leadership cares about the development of their young researchers. This applies especially to the doctoral students. Their number is remarkable but has been decreasing recently. These young researchers expressed a very strong enthusiasm with respect to their working conditions and future development chances.

The LSIWC continued to prove to be able to succeed in the competitive environment at the EU level. Overall, LSIWC's national and EU funding has not changed much, with the part of the budget from national sources, both public and industrial, being still small (although during the evaluation period this part increased from about 17% to 27% in relation to the entire budget) compared with EU funds and mainly used for improvements of the research infrastructure. This is a problem of the national system rather than LSIWC's. Taking into account the importance of the LSIWC for Latvia's economy, a significant stronger base funding is highly recommended; the situation of the LSIWC will be particularly difficult when EU structural funds decrease or disappear and the Institute will have to face the cost of maintaining and modernizing the equipment from national funds only. With the national base funding alone, despite its increase over recent years, the LSIWC could barely remain functional and productive.

Quality of Research

Score: 4 – very good

LSIWC is a unique institution for Baltic states, the only one working in the field of non-food bioeconomy in the area of forest resource use, also not so common in the world regarding its research profile. It is of high significance for Latvia since the use of wood and woody biomass represents an important factor of Latvia's economy. The area of research of the LSIWC has been focussed in recent years on biorefinery aspects closely connected with green chemicals and polymers as well as construction materials from woody materials with upgraded properties. The research activities can be described both as multidisciplinary and interdisciplinary addressing fundamental as well as applied scientific topics. The descriptions of the six laboratories differ somewhat in depth and quality, but overall, the research activities are at a high level by both national and international standards.

Important achievements of the LSIWC are the successful application of crude glycerol (a by-product of biodiesel production) as a substitute for petroleum-based polyols in rigid-foam production (e.g., polyurethane foams from renewable materials), the development of different technologies related to wood and its major components cellulose and lignin as well as for efficient use of plywood production side-products (e.g., betulin from birch wood processing by-products). LSIWC's researchers are experts in maintenance of wooden constructions and buildings. The extended list of national and international co-operations underlines LSIWC's visibility and acceptance by its peer institutions.

Impact on the scientific discipline

Score: 4 – very good

The publication list and the number of citations demonstrate a good visibility of the institute and its scientific output, and although there has been no substantial increase in the number of publications over the period from 2013 to 2018, the number of citations significantly increased (from 200 in 2012 to over 600 in 2018, according to the WoS database). The publications appear in reasonably good international reviewed journals and overall, these publications involve a significant proportion of all researchers listed by the LSIWC. During the review period the LSIWC publications received 1362 citations, which is good for a field of science that tends to be applied in its nature. The annual number of citations increased continually during this period from 200 in 2012 to over 600 in 2018, further substantiating LSIWC's continued positive contribution to the field and perception by its peers.

Apart from scientific publications and presentations at national and international events, LSIWC's members organised several events themselves and proved to be very active in the larger geographical Europe. The institute has international co-operations with leading research institutes and companies from almost all European countries and realises quite a number of international projects. LSIWC is one of the most successful research institutions in Latvia implementing EU projects; also, projects funded by ESA and further bilateral international projects are realised. The international competence of the LSIWC has been acknowledged by an invitation of the institute to become a partner in the potential ESFRI project ERIFORE (European Research Infrastructure for Circular Forest Bioeconomy). LSIWC is effectively using EU project funds for mobility of its researchers and students. Although visits by foreign researchers and PhD students take place at the institute, their number is quite modest.

There seems to be a strong focus on national needs and the developing of funding from Latvian and EU sources. LSIWC cooperates with a number of scientific institutions in Europe. However, it is not clear to what extent the LSIWC interacts with partners outside Europe, where similar research on high level is also carried out.

Economic impact

Score: 4 – very good

The economic impact of the LSIWC is focussed on creating a wide range of wood-based products and chemicals for construction purposes as well as for daily use. The institute cooperates with the Latvian Wood Industry Federation, the Latvian State Forests, and the Forest Sector Competence Centre of Latvia in developing innovative products from biomass, and also renders services in its research field. Research staff serves as experts or government representatives in different bodies related to state activity and the national economy.

Part of the related R&D activities are performed in collaboration with Latvian companies with an emphasis on SMEs. These SMEs include spin-offs from one of its laboratories. All but one of these national industry-related projects have a limited financial volume ranging from 1,000 to 37,000 EUR. All but one of the international commercial contracts are in the same range. No data are given on the current size and development potential of these markets. While in the past a small number of patents has been registered each year, none has been submitted during the period from 2016 to 2018.

LSIWC with its unique expertise is important for the ecological development of Europe. The institute is involved in European consortium ERIFORE aiming to enable Europe to take the lead in development and commercialisation of novel bio-based products. LSIWC is an attractive partner to both European academia and industry with its work on (i) biorefinery technology leading to a whole new range of innovative products from biomass which can contribute to sustainable development of Europe, (ii) food supplements from biomass which can provide positive impacts on public health.

Social impact

Score: 5 – outstanding

The economy-related activities of the LSIWC and their impact are nicely complemented by its activities presenting the importance of wood- and biomass-related knowledge and products to the non-academic sectors. The LSIWC uses various channels including social media to address the public. However, no quantitative data are given with respect to the usage of these offerings. An important side effect in the institute's contribution to society can be seen in its very active supporting role of the conservation of wooden cultural-historic building and works of art. On the downside LSIWC itself sees limitations in the potential for science to influence political decisions and societal developments and so limiting its overall impact.

LSIWC with its long-standing tradition of research in the field of biomass utilisation, offers an interesting workplace. Also, it provides a non-discrimination policy as an employer, with equal opportunity and gender balance. An important part of LSIWC's policy is its Human Resources Development Plan which puts great emphasis on helping early-career researchers and the creation of good conditions for their development. For young researchers it is an attractive place to work and perform research. All this was confirmed by interviews with PhD students and young scientists, during which one could see great enthusiasm and satisfaction with the research performed and atmosphere at the institute. The institute supports mobility of young scientists in the framework of its international projects. LSIWC, although not being a university, plays an important role in education of students in Latvia, especially at the level of PhD work.

Research environment and infrastructure

Score: 4 – very good

LSIWC's development strategy, research programme and research activities are tightly bound with the strategic framework defined in the EU and Latvian policy documents. LSIWC's research is organized in six laboratories covering different areas of wood and biomass utilisation and processing. The researchers are experts in their field and also the infrastructure has been decently upgraded in recent years with plans (worth supporting) for developing into directions

that allow the strengthening of its applied-science capabilities. All laboratories show well-defined plans for their future development, aiming to contribute to a sustainable national and international development by realisation of both basic fundamental and applied studies. Much emphasis is placed on research work with Latvian university students – who are considered to be the future staff of the LSIWC. There is a strategy in place to effectively help young researchers in their development (Human Resource Development Plan). LSIWC's laboratories and especially equipment are available to undertake very good research activities. With respect to this the institute has made good use of its extensive research cooperation within the European research programmes. Its equipment is reasonable modern - but not especially outstanding - allowing it to be competitive at an international level.

On the downside it's obvious very high dependence on European funds for all kinds of equipment puts the LSIWC into a difficult situation when these funds may become less readily available in the future. The national basic funding represents on average 21% of the sum of base and competitive research funding. With respect to the infrastructure funding the national contribution is a mere 7.5% representing a very unhealthy situation. The majority of the EU projects ended before 2018 resulting in the question how sustainable the funding situation of the institute will be in the upcoming years.

The use of EU funds to set up the hall for pilot plants could have represented an interesting complementary aspect to the basic and small-scale applied research plants, but currently it does not seem to be an asset but a liability. Industrial partner engagement seems to be minimal and the LSIWC is in urgent need to establish a sustainable financial and operational model to maintain this equipment. The long-term effect of this pilot-plant hall will only be positive when additional (national) funds can be secured to allow a continued operation of it. There is no visible strategy in place for making good use of this facility.

A somewhat unusually high ratio of lead researchers (LR) compared with researchers (R)/research assistants (RA) has to be stated (e.g., 2013 - 19 LR compared with 28 R and 22 RA; 2019 23 LR compared with 41 R and 21 RA) pointing to very small research units. Also, the numbers for visiting professors, researchers and students are very small and do not reflect the emphasis given to this group in the self-assessment report. The number of technical employees accounts for over 30% of the number of research staff, which seems good for an applied research institute. Administration staff is of the same number as the technical one, and in the SWOT analysis the administration staff are well assessed in terms of competences and experience in local and international project coordination and management. LSIWC's scientists supervise about 15 doctoral dissertations work with a full-time research staff of over 60, which is a good result for a non-university unit. The research activity of the institute is described on the web pages of the institute and in its publications. The institute's equipment is accessible for external users on the base dependent on the planned activity (either realization of research project or commercial activities).

Development potential

Score: 4 – very good

The Institute has ambitious plans for its future and intends, and also has the potential, to become a leading research centre in the Baltic non-food bioeconomy sector. The strength of the Institute are excellent researchers, modern research infrastructure and enthusiastic young scientists and PhD students. LSIWC is open to newly emerging research directions, like recent nano-cellulose studies. LSIWC very realistically assesses its strengths, weaknesses, opportunities and threats, and does a lot to improve its position regarding funds, research staff and equipment. LSIWC has a great opportunity to play a key role in further development of European research in the field of ecological utilization of biomass thanks to the invitation to partnership in potential ESFRI project ERIFORE (European Research Infrastructure for Circular Forest Bioeconomy).

It is to be expected that the LSIWC will continue its role as an important scientific and technological player at the national as well as international level in the field of basic and applied research on wood and wood-derived products and their usage in the future. The state national funding situation has to be viewed as critical and potentially harmful low, although in absolute numbers financial support from the state budget has increased significantly in recent years. Many of the EU-funded projects ended in the reporting period (longest run-time until 2021). It is not clear to what extent this essential international funding can be maintained in the near to mid-term future resulting in the question how sustainable the funding situation of the LSIWC will become. The institute has so far not succeeded in stabilising its financial situation leading to problems with the sustainable financing of its staff. This has the potential to negatively influence its future development potential.

This is especially true when looking at the urgently needed attraction of talented young researchers from universities who often prefer to develop their careers outside of Latvia. Without a continuous intake of these new researchers there is a substantial risk to lose competences when older researchers will retire.

It is in Latvia's interest to have decent financial support for this institute.

Potential to offer doctoral studies

LSIWC cannot provide a PhD programme of its own since it is not a university. However, every year about 15 PhD students are working on their PhD dissertations at the LSIWC. The scientific level of the supervisors from the Institute is high, also the necessary infrastructure is available with enough access for PhD students. The doctoral students presented a very enthusiastic view of their scientific development potential within the LSIWC. Overall, the number of doctoral students is high compared with many other institutions. On the downside, their number decreased by about a quarter (20 down to 14) over the period reviewed. The number of annually defended doctoral dissertations has been three on average but also with a decreasing trend due to the decreasing number of PhD students.

Alignment with Smart Specialisation Strategy

As stated in the self-assessment report, research topics of the LSIWC do align with 1st Smart Specialisation Area of RIS3 of Latvia which is "Knowledge-intensive bioeconomy", and the 1st priority "More efficient use of primary products for the production of higher value-added products, the creation of new materials and diversification of application" with the goal to promote the changes in the structure of production and export in traditional sectors, including forestry. LSIWC's research is also related to the 2nd Smart Specialisation Area of RIS3 of Latvia - "Biomedicine, medical technologies, bio-pharmacy and biotechnologies", especially to biotechnologies, as well as to the 2nd direction "Future growth of sectors in which exist or may be products and services with high added value" and the 3rd direction "Sectors with a significant horizontal influence and contribution to the transformation of the national economy", and to realisation of priority 6th "Developed knowledge base and human capital in areas of knowledge where Latvia has comparative advantages and which are important in the process of economic transformation". However, the part of the self-report addressing the RIS3 mainly describes aspects of this relevant to research activities of LSIWC. It does not become clear from the report to what extent the institute's output does shape significant parts of the objectives of the strategy.

Conformity with state scientific and technology development

The activities of the LSIWC do contribute to the achievement of goals of Latvia's policy regarding scientific and technological development, as defined in key documents (National Development Plan 2014-2020, National Industrial Policy Guidelines 2014-2020, Education Guidelines 2014-2020, and Science, Technological Development and Innovation Guidelines 2014-2020 and others). From nine priority directions in science for period 2018-2021, defined by the Latvia's Ministry of Education and Science, the LSIWC is involved in "Technologies, materials

and systems engineering for increased added value products and processes, and cybersecurity" and also "Research and sustainable use of local natural resources for the development of a knowledge-based bioeconomy". The institute participates in development of smart specialization (as defined in 2014 by research and innovation governing institutions led by the Latvia's Ministry of Education and Science), especially knowledge-intensive bio-economics, biomedicine, biotechnologies, smart materials.

LSIWC has an internationally competitive research staff in the fields of wood and biomass science, and also partially modernised infrastructure with plans for further upgrading. These elements allow it to realise Latvia's policy goals of economic growth by developing novel wood and wood-derived product technologies, simultaneously addressing the goal to increase the share of the population holding a higher education degree. The Institute has potential, but is slow in patenting novel developed products and transferring them to industry. Lack of national high-tech industry and of tradition in science-industry cooperation in Latvia, common problems of all post-communist countries, are largely to blame for this state of affairs. Therefore, the institute's efforts to improve this situation, namely caring for young researchers and undertaking common projects with industry, should be appreciated.

Recommendations

- The LSIWC needs further internationalisation: financial resources for postdocs are important along with the development of a competitive-application procedure for these positions (announced in international fora, like pages for Joint Postdoc Application initiative: itf.fys.kuleuven.be).
- Due to shortage of middle-generation employees, a strategy to attract international mid-career researchers is necessary and urgently needed.
- It is necessary to promote and support science-industry cooperation through dedicated grants with funds for both partners.
- The new hall for pilot plants urgently needs a strategic perspective developed together with industrial partners. This great asset for future applied research addressing TRLs 4 to 5 needs a solid financial basis for its significant operational costs, which mainly will come from industrial co-operations, allowing it to thrive.
- The LSIWC needs help in creating start-ups/spin-outs from its research results by, e.g., creating a proper legal framework supporting this as well as offering financial incentives like tax breaks for private investors; also, the Institute should establish a unit which helps with the commercialisation of its research results.

N_4 Research programme "Biology", Daugavpils University

2.7 Institute Data and Description

The research programme in "Biology" at Daugavpils University (DUBIO) brings together academic staff from 4 departments: the Department of Biosystematics, the Department of Ecology, the Department of Biotechnology, the Department of Anatomy and Physiology, and partly the Department of Chemistry and Geography. Research field includes fundamental and applied researches in the spheres of coleopterology, biosystematics, behaviour ecology, parasitology, nano-biotechnologies, molecular biology and genetics, aquaculture, botany etc. In total 55 academic staff and 16 support staff are involved into the work of DUBIO: 4 professors, 1 associate professor, 5 docents, 8 lecturers, 9 leading researchers, 16 researchers, 12 scientific assistants.

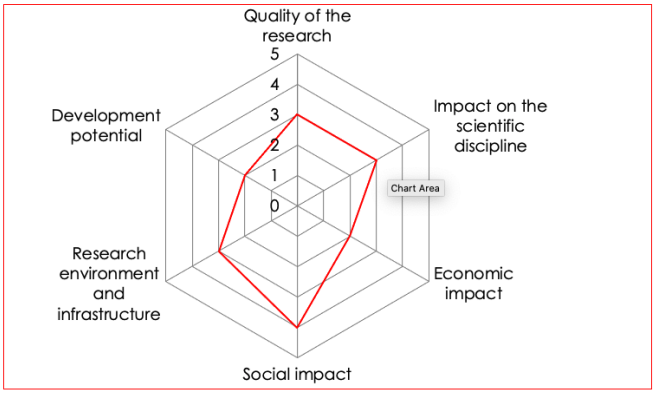
Daugavpils University research programme "Biology"	
Primary field of research	i) Earth and related environmental sciences, ii) Biological sciences
No. FTE academic personnel 2018	10.53
No. FTE academic research personnel 2018	30
Total number of FTE academic and research personnel 2018	40.53
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	312
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	73
Monographs in period 2013-2018	9
Patents Latvian in period 2013-2018	1
Patents (Europe and international) in period 2013-2018	0
Total no. of self-reported outputs in period 2013-2018	395
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	4.94
No. of all outputs in period 2018 per researcher in 2018	6.25
No of PhDs completed in period 2013-2018	9
No. of PhDs in period 2013-2018 per researcher in 2018	0.15
Total funding in period 2013 -2018 (Euros)	€ 4,149,558
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 102,382

2.8 Expert panel evaluation

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

Figure 4 Research programme "Biology", Daugavpils University Scores

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



Overall score

Score: 3 – good

The Research Programme "Biology", Daugavpils University (referred to as DUBIO) is a strong national player with a significant role in education and in advice for nature conservation. Its international visibility is low, except in the field of coleopterology. Lead authored publications in prominent journals, project leaderships, high level role in learned societies, editorial boards, etc. are largely missing. There were several comments from partners that DUBIO is more effective now, after the re-structuring following the first research evaluation in 2013. The number of staff is now appropriate for the research institute, but has not yet reached the level of an ambitious research unit that has set out a clear strategy for achieving international excellence.

Quality of Research

Score: 3 – good

DUBIO is a strong national player, with international recognition in a few areas, especially in entomology and as a manager of significant collections, while in areas of emerging importance, such as biosystematics, behavioural ecology, parasitology, nano-biotechnology, aquaculture, botany, is still needs to strengthen its position.

The scientific performance of DUBIO slightly increased in terms of the number of WoS/Scopus papers during the six years of evaluation. The number of such papers is around one per researcher per year, and 13 from the 15 most important publications show DUBIO researchers as lead author. This seems to be a good result. However, there are serious weaknesses behind these numbers: (i) 48 from the 314 papers were published by Baltic J Coleopterology, which is DUBIO's own journal, which poses a question of potential conflict of interest as well as a likely low impact in terms of readership (ii) The list of 15 most important publications show moderate performance: Half (eight) of the papers are from Q1 journals with six papers lead-authored by DUBIO researcher, and nine papers have IF larger than two. Therefore, DUBIO during the six years of evaluation produced only six high level publications (that is DUBIO lead authored in Q1 journal). In addition, DUBIO lacks multidisciplinary "top" publications. The conclusion is that DUBIO publishes a good number of WoS/Scopus papers, but mostly in journals with low/moderate quality indicators (IF, Scimago), and with around 15% in their own journal.

Impact on the scientific discipline

Score: 3 – good

DUBIO is a strong national player with limited international recognition. It has an internationally recognised role in entomology, specifically in coleopterology. It maintains large (200 thousand specimens of 12,000 or 15,000 species (contradictory numbers in the self-assessment), collections, databases, publishes an English journal (indexed in Scopus, but not WoS), and manage two carabidologist networks, one in the Baltic, and one in the Philippines. There is a

large number of cooperations with universities and museums worldwide, e.g. with the Mindanao University (Philippines), Senckenberg Museums (Germany), etc. Beyond entomology, there are also collaborations with a good number of international institutes. The Erasmus scheme is actively used, which improves its international character, although mostly for students. In general, however, international visibility is low, which is indicated by the (i) only four invitations to give plenary talk at meetings; (ii) international meetings organised by DUBIO, like the International Scientific Conferences of Daugavpils University, with probably limited international character, or specialised (e.g. meetings in Baltic coleopterology); (iii) missing editorship in Web of Science journals.

Economic impact

Score: 2 – adequate

DUBIO has a low level of interactions with the economy. The most important research and innovation collaborations reported are mostly via EU support for infrastructure development as opposed to collaborations with businesses. One spin-off was established on the basis of DUBIO activities (although two are mentioned later in the section 1.14 of the self-assessment report), but no details are given on their role and performance. The business income, including both the private sector, and state institutions, was 209,291 euro during the evaluation period. The investment from ERDF for market-oriented researchers was of the order of 1.5 million euro, but no information was provided on how successful these were e.g. in terms of uptake by economic players. DUBIO has a negligible role in the private sector, the impact of its research is indirectly linked to the economy via the conservation of sustainable environment and ecosystems and providing expert advice to the government.

Social impact

Score: 4 – very good

DUBIO is a very important R&D partner for non-academics. As a university, DUBIO has a strong impact on society via the students, and related educational activities. DUBIO's science communication activities increased (almost doubled) in the evaluation period. It organised activities to involve elementary and secondary school students to the university "era", via camps, photo exhibitions, and excursions (e.g. "School of green biologists"). In a period of declining university student numbers, these are crucial to attract the interest of school age children in higher education in biology, and to show scientific activities and research life. Camps for people with special needs were also organised, which is a nice service to the society. DUBIO Cooperates and its staff have expert roles in national bodies, mainly in the sector of nature conservation (Nature Conservation Agency), plant protection, regional planning, museum and zoology. DUBIO expertise is widely applied in the government's nature conservation planning (Nature Protection Department at Ministry of Environmental Protection and Regional Development) and in state forestry management (Latvia's State Forests). Advisory roles in aquaculture/fishery are also significant, although this area is not well represented in the scientific outputs, thus has less visibility outside of Latvia.

Research environment and infrastructure

Score: 3 – good

DUBIO is only a strong international player in the sense that it is well-equipped and its premises are new and modern, comparable to the best laboratories worldwide. Part of DUBIO moved to the new Building of Life Sciences, where offices, and well-equipped laboratories are available. The "online site visit" clearly demonstrated the high level "hardware" possibilities of DUBIO. Two international level collections (plants, beetles) are stored in modern collection facilities. Thus, the availability and quality of support services, research infrastructure, and databases are at a high international standard. Regarding human resources, however, there was no increase in the number of academic staff. The lack of visiting researchers keeps DUBIO as a national institution, even with foreign students from the Erasmus scheme. The number of

completed MSc is sharply decreasing, similarly to the number of staff enrolled in doctoral studies. These indicate a lack of potential for increasing the number of researchers, not mentioning their competitiveness (i.e. quality). The system to reward high impact factor (IF) publications and increases in salary are potentially good ways to promote more visible research, but from the self-assessment report there is no sign that it has had an effect. Another issue which was not made clear is how the management is organised and how decisions at DU and DUBIO are made.

Development potential

Score: 2 – adequate

The development potential of DUBIO is adequate to maintain its strong national role, however, less ambition is evident in becoming a stronger international player. On the positive side, the reward system for high IF papers, and the involvement of elementary and secondary school students to DUBIO activities, may push research into good directions, and will provide new students in the long term. While these are positive, these will not make a major change as there is a lack of strategic thinking in terms of research directions. However, during the period evaluated there were no signs of increased scientific quality (only in quantity) and there was a decrease in MSc theses and doctoral students, which questions any development plans. The low international visibility means low competitive power, and low cooperation networks in cutting edge topics. There are no clear strategic directions set, except general statements, like DUBIO requires new knowledge, equipment, and a need to identify income sources, etc., or DU trying to attract the most talented young people. The only plan stated was to make efforts to keep the best of their own early career people at DUBIO. Funding does not seem to be secured, e.g. the lack of international competitive grants from the EU (FP, H2020) highlights financial weakness and fragility. The research infrastructure is excellent, but there seems to be a lack of ambition and long term thinking.

Potential to offer doctoral studies

The infrastructure to support education is excellent, but there is low ambition to fully utilise it with a high number of students, except to keep their own good students. This is not far enough to be attractive. No strategy and no necessary steps were provided to attract students from other institutions, or from abroad. There are no internationally leading researchers and seniors, which makes DUBIO labs less attractive for ambitious students, except for the field of coleopterology which is an exception). DUBIO needs to target the EU wide pool of students. The best students will not only search for good equipment, but will search for cutting edge labs – and this ambition is missing.

Alignment with Smart Specialisation Strategy

DUBIO partly fits the RIS3 investment priority "Modern education" considering the available top level research infrastructure. The Smart Specialisation Strategy has a priority area on knowledge based bioeconomy, where DUBIO has an active role in developing nature-friendly forestry and agriculture. However, the magnitude of it cannot be assessed from the documents. Both forestry and agriculture are the base for bioeconomy. Bioeconomy is an EU priority, thus putting DUBIO research more into an international bioeconomy context would help to create links with other institutions.

Conformity with state scientific and technology development

DUBIO fits to RIS3 specialization are "Knowledge intensive bioeconomy". DUBIO has knowledge on biodiversity, systematics, biological monitoring, and related fields. These have an increasing role in the new EU strategies under the Green Deal, e.g. the Strategy on Biodiversity, where ecosystem restoration is a major - and legally binding - task. Effective restoration requires background information on ecosystems and biodiversity, and here DUBIO has a role. Similarly, monitoring will be the priority axis in the new European Biodiversity Partnership. Thus, DUBIO may be most useful for Latvia as a local knowledge holder and supports EU priority actions and

policies and Sustainability Goals in the country. Efforts of the institution to improve human resources and students' involvement are insufficient. Collaboration with administration and state companies is good, while collaborations with private and business sectors is rather weak. More ambitious steps towards their integration in international networking and projects is needed.

Recommendations

The main weakness of DUBIO is linked to the lack of a clear strategy for its development, which probably contributes to a "business as usual" approach and a lack of dedication and motivation to continue improving. The recommendation is for the Institute to expand its research vision and implement an internationally focused strategy as follows:

Increase the impact of its research, in particular by increasing the quality of the scientific publications (to Q1) and international visibility. This latter may include: increasing authorships in top journals, lead authorship in leading interdisciplinary journals; membership in international research bodies including high-impact journals' editorships, society board; increasing mobility of the researchers; organising high level and/or large meetings.

- Motivate DUBIO researchers to initiate new research directions. There are a variety of motivation techniques (e.g. salary, research fund, awarding etc.)
- Increase the capacity to join international consortia for EU proposals and increase the rate of success in national and international funding opportunities
- Attract PhD students from all over the EU to improve the number, composition and quality of staff, and more generally, improve the engagement at higher educational level at national and particularly at international level

A major constraint to the implementation of a successful strategy may be the lack of a dynamic management, capable of turning the recent consolidation of the institute into an opportunity to increase performance by stimulating and encouraging synergies among the different areas of the Institute. It is not clear how the reporting hierarchy functions and how the management is structured.

The premises and equipment, i.e. the "hardware", are of international level, but their international and national attractiveness and visibility need to be improved. Besides, researchers are the main asset of DUBIO. The priority should be to improve the number, composition and quality of staff. It seems it is not possible from within Latvia – thus PhD and postdoc funding systems need to be developed to provide European salaries to attract foreigners. Without an increase in human potential, most of the investment of the structural developments won't be fully utilised. PhD students are the future of this Institute and their capacity to learn and grow in a stimulating environment should be a first step. A major recommendation is for DUBIO to favour long visits (at least 6 months) of PhD students to prestigious international universities or research institutes, thus much beyond visiting project meetings. To favour a more international environment DUBIO should attract foreign students and foreign researchers. An opportunity to invite leading researchers could be the organisation of doctoral training programs, which would benefit both the PhD students and the more senior researchers. The organisation of training and doctoral programs could be carried out in collaboration with other national institutes and universities that share similar research objectives in Latvia. As DUBIO staff is small, probably collaboration with existing doctoral programs or with universities to establish new ones is the way for organising successful doctoral programs.

Regarding funding, involvement in EU framework proposals should be enhanced, particularly in areas of the widening programmes, such as ERAChair and twinning, where DUBIO can act as a coordinating institution.

According to the EU Green Deal and the new Biodiversity Strategy, there are new priorities like restoration of ecosystems and monitoring the state of functionally important groups, like pollinators. This requires investing into the classical disciplines like entomology, and there is an

emerging value of collections (e.g. as information sources on the past, and more natural states of the environment). These investments mean new techniques for monitoring (drones in remote areas, LIDAR, involving citizens, and environmental DNA, etc.) which should be applied more widely, and tailored to the Latvian socio-ecological system. Thus, DUBIO may be most useful for Latvia as a national knowledge holder, and supporter of EU priority actions and policies and Sustainability Goals in the country.

N_5 Cluster of Natural Sciences, University of Latvia

2.9 Institute Data and Description

The Natural Sciences Cluster at the University of Latvia (NSC-UL) consists of five faculties, a Botanical garden and eight institutes. In 2018 NSC-UL employed ~65 academic personnel FTE and ~582 academic research personnel FTE and secured €41m of funding. The main areas of excellence for the cluster are innovative information technologies, mathematical methods as promoters of exact sciences excellence, climate change and adaptation, innovative and nature-based materials, nano and quantum technologies, photonics, ecology and biodiversity, biotechnology, satellite geodesy, and geodynamics.

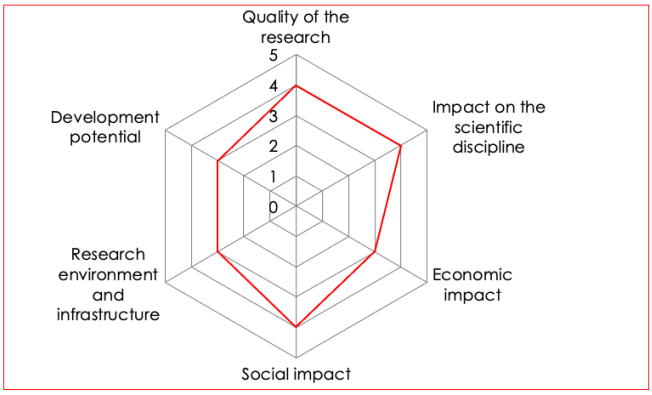
University of Latvia Cluster of Natural Sciences	
Primary field of research	i) Mathematics, ii) Computer and information sciences, iii) Physical sciences, iv) Chemical sciences, v) Earth and related environmental sciences, vi) Biological sciences
No. FTE academic personnel 2018	64.66
No. FTE academic research personnel 2018	315.64
Total number of FTE academic and research personnel 2018	380.3
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	2134
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	378
Monographs in period 2013-2018	28
Patents Latvian in period 2013-2018	36
Patents (Europe and international) in period 2013-2018	14
Total no. of self-reported outputs in period 2013-2018	2590
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	5.611359453
No. of all outputs in period 2018 per researcher in 2018	6.810412832
No of PhDs completed in period 2013-2018	199
No. of PhDs in period 2013-2018 per researcher in 2018	0.523271102
Total funding in period 2013 -2018 (Euros)	€ 52,431,666
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 137,869

2.10 Expert panel evaluation

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

Figure 5 Cluster of Natural Sciences, University of Latvia – Scores

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



Overall score

Score: 3 – good

The Natural Sciences Cluster of the University of Latvia is a large and diverse cluster comprising fourteen entities (faculties, departments, institutes). There are big differences between the entities in tradition, research objectives and methodology, and scientific output. In addition, in such a large cluster, the entities range considerably in the scale and quality of research undertaken.

The overall score of the cluster is a strong 3. Parts of the cluster, if evaluated separately, would have received a higher score. In particular, the group on quantum computing can be considered a global leader. On the other hand, there are groups with little activity and a low scientific output.

The University of Latvia decided to form the cluster as the 'submission entity' for the evaluation and it has had some positive effects, although the reason for presenting this cluster was not clear. The cluster has brought scientists from different disciplines together. The new building, the House of Science and other infrastructure has increased the daily interaction between the scientists and has triggered interdisciplinary research. There is, however, room for development of the cluster and its management.

The cluster has a quite high economic and societal impact. It has good relations, on the one hand, to industry and small enterprises and to ministries and governmental bodies on the other hand.

Quality of Research

Score: 4 – very good

This is a large cluster comprising fourteen departments (or institutes or faculties) and most of the classical disciplines of mathematics and the natural sciences. The cluster carries out both basic research and applied research, as well as industry-oriented research.

Because of its size the cluster is necessarily heterogeneous and it is therefore quite a challenge for the evaluators to give a single assessment of the whole cluster based on the information provided in the form of self-assessment report, bibliometric analysis, virtual site visit and interviews. Some parts of the cluster are very good indeed, others less so. In particular, the research group on quantum computing is internationally renowned as a leader in the field. This group has an ERC advanced grant (the only one in Latvia), which is a clear sign of quality. The young researchers and PhD students are enthusiastic, which promises well for the future.

An important part of the research carried out at the cluster is of interdisciplinary nature. For instance, the Faculty of Computing collaborates with the Department of Physics on quantum computing and with the Faculty of Biology on bioinformatics. The Institute of Atomic physics and Spectroscopy collaborates with the Faculty of Chemistry, the Faculty of Physics and the Faculty of Medicine in the priority areas of Atomic Physics, Optical Technologies and Medical Physics. The Department of Physics collaborates with the Institute of Chemical Physics and the Institute of Microbiology and Biotechnology. The interdisciplinary research is a comparatively new development and it is hoped that it will lead to new high quality results.

There are a number of publications produced as the result of international collaboration. This is a clear improvement from the 2013 assessment. On the whole, the cluster has a good level of international activity, both visits by members of the cluster to foreign institutions and visitors from abroad to the cluster. This adds to the quality of the research.

Impact on the scientific discipline

Score: 4 – very good

There are a considerable number of papers published in high impact journals. The number of papers slightly increased in the evaluation period. The listed most important papers have high IF, four were published in top multidisciplinary journals (Science, Nature Communications, Nature Nannotechnology), with one paper has NSC-LU researcher as lead author. They are also reasonably well cited. Members of the cluster are frequently invited to international conferences, but not so often as plenary speakers at the best conferences. There is also a fair number of memberships on editorial boards of international scientific journals.

The aforementioned ERC advanced grant and the fact that the cluster hosts EU framework programme projects is also a sign of international recognition and thus impact.

Economic impact

Score: 3 –good

The cluster has a lot of collaboration with industry and enterprises that appear to be successful. They have 36 Latvian patents, 10 European patents and four other international patents in the period 2013 - 2018. The cluster has contributed to the establishment of four spin-offs. There are project-based collaborations not only with Latvian firms but also with international enterprises.

It should also be emphasised that the basic research in quantum computing will most likely find important practical applications of economic value in the future. And indeed, many small companies as well as the ministry show great interest in collaboration with the quantum computing group.

Social impact

Score: 4 – very good

The cluster covers a wide range of disciplines and provides advice to the society in various ways. Its research results are used, for instance, in information and communication technology and in forming sustainable development policy - the ecological research provides support to the Latvian environmental protection and nature conservation efforts.

There appear to be good connections to decision makers. Experts from the cluster are members of the advisory board of the Ministry of Agriculture and also in international bodies such as the Intergovernmental Platform on Biodiversity and Ecosystem Services, the Panel on Genetically Modified Organisms of the International Food Safety. Researchers in the cluster are also involved in non-academic bodies, mainly Latvian, but also Danish and German bodies as

well. Thus, society benefits both nationally and internationally from research and advanced knowledge of the cluster and the doctoral and post-doctoral training is good and serves society.

Science communication and outreach are diverse and well organised via social media, science cafés, visits to schools, public lectures, TV programmes and other means.

Research environment and infrastructure

Score: 3 –good

The scientific equipment is new, modern and up to date. The buildings are new. As a matter of fact, the new natural science campus has brought together most of the science units into the same location. This has facilitated and in some cases even enabled new interdisciplinary collaboration. This is a very promising development with encouraging preliminary results. Besides the buildings, field stations, botanical garden, taxonomic collections are available for living-nature oriented research. A long list of expensive equipment were listed, together with software. The academic research staff is increasing in number, suggesting that the new infrastructure will be effectively utilised. Visiting researchers are, however, scarce, and efforts are needed to increase it. These – and other experiences during the evaluation – indicate that the unit is well-organised, managed along a proper strategy, and provides an attractive research environment. The presence of low performance groups, however, introduce a weak point, providing examples not to follow.

Development potential

Score: 3 –good

There is a clear vision of NSC-LU to be a science university, competitive at the ERA scale. It entered a monetary stimulus system based on WoS papers, interdisciplinary PhD schools to attract students (Latvian and foreign), and an internal grant system. Such a rewarding environment should give the basis for development of human resources. The new buildings and infrastructure have the potential to attract visiting scientists. There are new, trendy research directions established (e.g. near-term quantum computing), and a number of good steps are envisioned (support for applications, commercialization, etc). The cluster has a well formulated strategy and a clear vision of its development potential. There exists an institutional development plan and a plan for development of human resources. The plans suggest means to achieve the objectives and to monitor the progress.

Among other things, the cluster aims at increasing its scientific competitiveness by promotion of international collaboration, raising revenue from knowledge transfer, such as from private sector funding, and offer staff, research personnel and PhD students competitive salaries.

These are all good objectives and the main obstacle to achieving them might be the lack of funding. The cluster has depended heavily on funding from the European Regional Development Fund and this source of funding will inevitably peter out. The cluster is aware of this and seeks means to compensate for decreasing ERDF funding. The cluster strives to secure private funding (both national and international) but acknowledges the need of support from public sources as well. The diversity of national and international funding sources (ERC, FP, H2020, Interreg, etc) provide stability for operating NSC-LU and its researches. There are some trends, however, which raise concerns: the number of MSc theses declined, similarly for PhDs, indicating a lack of interest in students.

Potential to offer doctoral studies

Currently the education of PhDs is working well with a good number of new PhDs graduating each year. Prominent professors from other institutions are involved in the education of PhDs. This increases the teaching capacity and quality and also shows the importance of mobility to the students.

Again there is considerable heterogeneity and incoherence between the groups within the cluster. The requirements for a PhD degree differ between the departments, for instance the amount of course work included in the PhD curriculum. Also, the salary paid to the student depends on whether the research group has external grant money or not.

A significant part of the PhDs that graduate from the cluster are employed by universities and research institutes and they continue to work in the same scientific discipline. Only a few are employed by ministries and national agencies and still fewer make their career in industry. It would be good if a greater fraction of the PhDs would find work outside academia.

The cluster has the potential to educate more PhDs than presently, but the lack of sufficient funding limits the number of doctoral students.

The PhD programme is currently being restructured with the aim of establishing doctoral schools. This is a positive development and an opportunity that should not be missed.

Alignment with Smart Specialisation Strategy

Most priorities of Smart Specialisation Strategy are also priorities of the cluster. The cluster works on energy efficient buildings, new information and communication technology and software development, create new study programs to fit needs of the labour market, explore national mineral resources, and large part of the research is devoted to knowledge intensive bioeconomy. The cluster's cutting-edge research topic, quantum information technology is of global importance. The research at the cluster therefore aligns very well with several of the objectives of the strategy.

Conformity with state scientific and technology development

The cluster has a well-shaped pyramid of people, with many good students at the basis, a good number of scientists in their mid-career and a few internationally renowned researchers at the top. The collaboration with industry and small enterprises is working well and an enlargement of this activity is in prospect. Lately, an effort has been made to increase international collaboration in research as well as in doctoral education. Research on estimation of cost optimal energy efficiency of buildings in Latvian climatic and economic conditions is pursued in collaboration with the Ministry of Economics Research. This is related to the priority "increasing energy efficiency" of the Science, Technology Development, and Innovation policy. Therefore the research at the cluster aligns well with several of the policy objectives.

Recommendations

The cluster was evaluated in 2013 in a different constellation and it has responded well to the recommendations of that evaluation. Some of the measures undertaken have not yet been fully implemented and the panel recommends that efforts are made to continue with these plans of action. In particular, the panel has the following recommendations.

1. The cluster should actively recruit professors and researchers, post docs and PhD students from abroad. All open positions should be advertised internationally.
2. Increase researcher mobility by encouraging PhD students and postdocs to spend time abroad.

3. International collaboration should not be restricted to attending conferences and distributing information on networking events. Real collaboration in terms of e.g. visiting professorships is needed.
4. A strategy for securing external funding is now more important than ever when funding from the European Regional Development Fund is likely to decrease. It should include developing potentials (e.g. staff, collaborations) in areas which will be key in the coming Horizon Europe funding scheme (e.g. digital technology, climate, food, natural resources and environment).
5. The cluster is large and heterogeneous and therefore in need of good leadership and management. Currently the faculties, departments and institutes are separate units with some common interests. Good interdisciplinary research has commenced. The requirements for obtaining a PhD differ between the entities of the cluster. The panel therefore has the following suggestions.
    i) Make a plan for how the cluster should be managed in the future to best serve the scientific and educational objectives.
    ii) Encourage and make funds available for interdisciplinary research between the entities of the cluster.
    iii) Lot of attention should be paid to the reconstruction of the PhD programme which is already under way. The requirements for a PhD should be consistent and coherent throughout the cluster – including providing the same salary to all PhD students independently of where the funding comes from. It would also be desirable to make the requirements in better alignment with those of most other European countries as this would facilitate student mobility.

A Scientific Advisory Board (SAB) should be established. The SAB should consist of internationally renowned scientists in the research fields of the cluster. In particular, the SAB could give advice on leadership and management issues, prioritisation, establishing interdisciplinary links between the entities, and the reconstruction of the PhD programme.

N_6 Ventspils University of Applied Sciences Natural Sciences Research Platform

2.11 Institute Data and Description

Ventspils University of Applied Sciences (VUAS) delivers research and services several branches of astrophysics, methods of radio astronomy and radio interferometry, remote sensing of the Earth, and computer and information science. The majority of this research is carried out within the Ventspils International Radio Astronomy Centre" (VIRAC). VUAS has 17 doctors with expertise in natural sciences and mathematics. Large part of funding comes from projects, being strongly variable. The funding of natural sciences in 2013-2018 was 7,472,271 EUR.

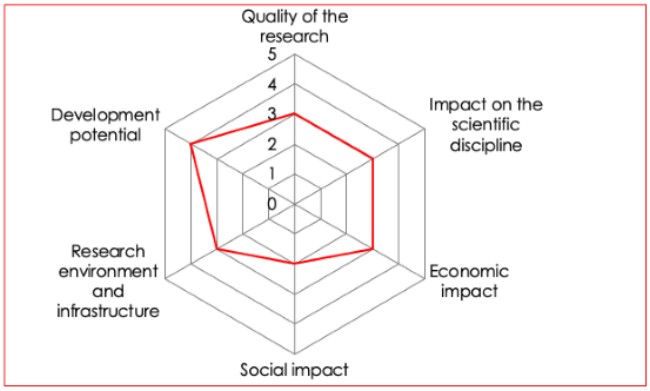
Ventspils University of Applied Sciences Natural Sciences Research Platform	
Primary field of research	i) Computer and information sciences, ii) Physical sciences, iii) Earth and related environmental sciences
No. FTE academic personnel 2018	3.171
No. FTE academic research personnel 2018	17.78
Total number of FTE academic and research personnel 2018	20.951
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	79
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	13
Monographs in period 2013-2018	2
Patents Latvian in period 2013-2018	0
Patents (Europe and international) in period 2013-2018	0
Total no. of self-reported outputs in period 2013-2018	94
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	1.34
No. of all outputs in period 2018 per researcher in 2018	1.59
No of PhDs completed in period 2013-2018	2
No. of PhDs in period 2013-2018 per researcher in 2018	0.04
Total funding in period 2013 -2018 (Euros)	€ 6,648,402
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 317,331

2.12 Expert panel evaluation

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

Figure 6 Ventspils University of Applied Sciences Natural Sciences Research Platform – Scores

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



Overall score

Score: 3 – good

The Ventspils University of Applied Sciences Natural Sciences Research Platform (VUAS) has a strong research programme, mostly of national importance with some areas of international importance, particularly in astrophysics. Its radio telescope infrastructure is of international importance. However, the self-assessment report contained several unsubstantiated assertions and a general incoherence that were only partially clarified during the virtual visit. There is a need for better management and cohesion in the unit as a whole. Astrophysics in particular must urgently establish a sound strategic plan to exploit the opportunity provided by the retirement of several senior staff. There is scope to increase the interaction with local industry and to establish commercial income streams. There is a need to develop a coherent strategy for the institute that encompasses a research strategy, succession planning and a financial model, if the unit is to be able to fulfil its great potential.

Quality of Research

Score: 3 – good

The VUAS group is a strong national player and has a small number of strategic international collaborations. The research programme is very broad for the number of researchers involved. It is strongly centred in Astrophysics, with other activities in remote sensing, computing and studies of the brain. Some aspects of the astrophysics programme are of high quality, in particular aspects of star formation and interstellar grains and ice formation. Some of the other areas, in particular solar physics and radiative transfer, are only of national significance. The work on brain tissue conductivity is of high quality, innovative and agenda-setting. No other work in the computing and informatics domain was submitted for review, so the evaluation only took account of the neuroscience activity in this area. The unit reported at the virtual visit that other activities in computing and informatics were commercially confidential. The remote sensing work is worthy and certainly useful for applications but not of high quality scientifically. The number of research articles per researcher is comparatively low, taking into consideration the substantial funding. It is well under the average for the other Latvian institutions reviewed by this panel. However, the unit claims that the statistics are substantially underestimated since the unit has changed its name several times in this period and thus some publications are not picked up by standard methods. The number of PhDs has increased in recent years, though only two have defended their theses.

Impact on the scientific discipline

Score: 3 – good

Given the contents of the self-assessment report, only the activity in astrophysics can be properly evaluated. The research foci of VUAS include international collaboration, as evidenced by the ability to attract well-regarded guest researchers and peer-reviewed papers resulting from teams from CAS and MPIE. This is further supported by VUAS' responsibilities as operator/manager of the Latvian radio telescopes. The current set of radio telescopes is now being augmented with a LOFAR station; LOFAR is a major international collaboration in radio astronomy. The VUAS group is assuming technical, scientific and strategic national roles for the exploitation of this facility. Several of the outputs submitted for review are of high quality, so that, in some of the areas of astrophysics, there are distinctly influential papers. There are a number of important international collaborations in both this area and that of neurological studies that should be continued. Some of the papers contain data taken at a number of important instruments where time is granted by international peer-review competition. Thus there is a basis for increasing the strength of the science output of VUAS. In summary, the impact on science is mostly of national significance, with some areas of international significance, with high potential for significant improvements.

Economic impact

Score: 3 – good

VUAS has a strategy whose main pillar is to pursue fundamental research in astrophysics. As their self-assessment states, VUAS uses the tools and technologies from this fundamental science to underpin aligned advances in earth sensing, solar studies (including solar-related space weather) and medicine. The remote sensing group and the computing group produce work with clear economic impact. The work presented in the publications submitted here promises significant applications in energy conservation by remote sensing of heat loss and in forestry density estimation. At the moment however, such applications lie in the future. The work in astrophysics might seem rather divorced from economic impact, but it is well established that effort devoted to curiosity-driven research pays major dividends both in serendipitous discovery, unforeseen applications of techniques and attracting bright young people into science who themselves might make important economic contributions. In the area of astrophysics, such contributions can quite often be in remote areas, such as finance. However, there is a rather low level of interactions with other sectors of importance for the economy. VUAS represents Latvia in defining the strategy and operations of the European VLBI Network (EVN), and the International LOFAR telescope (ILT). In these forums, VUAS provides national leadership to further develop radio astronomy technologies, scientific research and potential for wider impacts (e.g. space weather) for Latvia.

Social impact

Score: 2 – adequate

There is very little information on the social impact of the VUAS in the self-assessment report. Although mention is made of various activities, including the role of the radio telescopes as an attractor for young people, few details are given. It is positive to see strong contributions to science fora, and a few presentations of activities in popular science articles are mentioned. However, given the attractiveness of astronomy to the general public, a disappointingly small number of such outputs has been produced, in comparison to other centres that the panel reviewed. Some activities have been implemented in the area of remote sensing, including engagement with agencies and the private sector in recent years. The VUAS web page, although apparently new according to information given at the virtual visit, is rather standard and many of the outputs such as on YouTube are not easy to find. The communication strategy and outreach to the general public needs further enhancement. Astrophysics is a key area to attract young people into science. In particular, the radio telescopes are a key resource for excellent public engagement. In terms of social benefits, such as higher education and health care, the self-evaluation report clearly shows good intentions; However, there is still a lot of room for further development of social impacts.

Research environment and infrastructure

Score: 3 – good

The physical infrastructure of VUAS is impressive, dominated by the various radio-telescope installations. The basic funding from the Latvian government is insufficient and very concerning, although the VUAS staff are to be congratulated for their success in gaining grants. The removal of the funding for the maintenance of the radio telescopes in 2019 is a major problem. An application for this to be reinstated should be made urgently, together with a request for an upgrade to the large radio dishes. Unless these are both maintained and upgraded, their usefulness in cutting-edge research will inevitably diminish. As reported at the virtual visit, the group has plans to use funds gained from planned satellite communications activities towards the maintenance of the telescopes. Nevertheless, a larger basic funding from the government would have many advantages, in particular in allowing more science to be done, since time taken in making many grant applications would be gained for research. Other physical infrastructure, such as upgraded labs and computing facilities, seems to be impressive, although little detail was given either in the self-assessment report or in the video prepared for the panel.

The overall organisation of VUAS seems to be strongly devolved to the various research groups in astrophysics, remote sensing and computer science. Coherent planning for the unit overall, as well as for astrophysics in particular, seems to be lacking. Each of the major fields of study has a particular niche and potential, but how they complement each other and how to strengthen the position of the VUAS on the national and international scene is not clear from the self-assessment report. Remote sensing and computer science, which represent a minor component in terms of staff and resources, have strong potential in the longer term to open VUAS to various challenges for the society. In the field of remote sensing and computer science, it is unclear from the self-assessment report how VUAS intends to strengthen its future role in light of very strong competition. The clear excellence in some areas of astronomy research could be better exploited at the EU level.

The impending retirement of five members of the astronomy group represents both a challenge and an opportunity. They should be replaced with young staff who can open up new fields of research and consolidate existing fields. The breadth of the current research, given the number of research staff, is too great and the retirement of researchers pursuing areas for historical reasons is an opportunity for necessary rationalisation. The small number of doctoral students and the lack of a doctoral programme is a major concern. It is clear from the meeting with young researchers that they are happy and feel fulfilled; They emphasised the advantages of working at a well-equipped facility with no constraints on equipment availability. However, they also are clearly starved of interaction with their peers and a normal research environment in which many young people can learn together both from themselves and from senior scientists. The VUAS management needs to carefully consider plans to improve this worrying situation.

Development potential

Score: 4 – very good

VUAS is modest in size but has excellent potential to develop its international profile, particularly in the field of astrophysics. It is important that VUAS is able to support its research infrastructure, as it does today, in all parts of its work, including high-performance computing. This access to high-performance computing will be a route by which VUAS can play a major role in fundamental radio-astronomy research, and also how VUAS can provide advances in algorithms and techniques that will be of great interest to its international partners (EVN, ILT).

The VUAS has research activities that are underfunded but still in parts excellent. Increases in funding would allow a significant increase in research output. The neurological work seems highly promising and the international collaboration underpinning it should be maintained and

strengthened. Strengthening of the applied science activities, which are more closely aligned to government strategy, would pay dividends. The potential of the institute is that it has several rather strong activities that could easily be expanded if more resources were available. Options for private sector funding for astronomy are very limited though there may be some opportunities for such funding in the fields of remote sensing and computing.

The future vision and plans are not sufficiently clearly addressed throughout the self-assessment report. Stronger actions to reach a stable position in undergraduate and postgraduate students would help the VUAS to get a better flow of PhD students, potentially raising new excellent researchers at VUAS. The panel found it difficult to understand why the researchers are heavily overloaded by teaching, but the number of students is relatively low. Founding an in-house doctoral programme is perhaps the greatest potential development with the largest payback of all, however the panel was informed during the open meeting that this is against the current policy of the Latvian government, which prefers to concentrate graduate schools in larger universities or consortia of institutions. Taking part in such a consortium should be investigated. The number of visiting researchers and research students at VUAS is also still very low.

The most serious aspect that needs to be solved to exploit the large potential of VUAS is a future research strategy. No compelling vision for the future of the astrophysics activity at VUAS was evinced in the self-assessment report, in the virtual visit or in the response to the panel's questions. A long-term plan to rejuvenate the research staff in the light of imminent retirements needs to be drawn up as a matter of urgency. This plan should address how to attract world-class scientists from outside Latvia, who would find the remarkable VUAS infrastructure attractive and who would increase the output of world-class research papers. The plan should also encompass the selection of the best strategic directions for future research that could guide the general areas in which positions should be advertised. The development of this plan requires the advice of the VUAS International Advisory Board, which for this purpose might be strengthened by the addition of a number of members drawn from well-known astronomers who do not collaborate with current VUAS staff. The board should continue to give advice on VUAS's direction beyond the implementation of this plan.

Potential to offer doctoral studies

The lack of an in-house doctoral programme is a major weakness in the research environment that should be urgently addressed. Although students are involved in VAUS they are registered with other universities, which is far from ideal. A unit such as VUAS, which has world-class infrastructure, needs a dynamic cohort of PhD students and young researchers, for whom it can provide world-class research projects. Such a cohort does not currently exist. VUAS needs to consider urgently how it might either found its own doctoral programme or at least associate itself closely with another one that will provide a critical mass of young researchers sufficient to maximise the potential of the infrastructure.

Alignment with Smart Specialisation Strategy

There is significant VUAS alignment with the Smart Specialisation Strategy. It is pursuing modern ICT systems, advanced knowledge and human capital development, which align with the fifth priority, although insufficient detail was provided in the self-assessment report to allow this to be evaluated. It is involved in pursuing world-class radio astronomical research: this requires innovations in (electrical) engineering, ICT technologies and software (smart algorithms). In the past, there have been significant transfers of technologies from radio astronomy to medical diagnostic systems, engineering systems and ICT, so VUAS's strategy has some alignment with the national knowledge specialisation towards new medical technologies. Some work on energy studies was mentioned in the self-assessment document but not elaborated on. Remote sensing of energy consumption in Latvian towns was described in one of the submitted papers, which aligns with "smart energetics". Smart technologies and engineering systems are crucial to the operation and development of the radio-telescope installations. The astrophysics

research provides intellectual capital that underpins all the Smart Specialisation Strategy objectives.

Conformity with state scientific and technology development

The main contribution of VUAS to the Latvian governmental objectives is in the provision of people trained in research and the exact sciences who can go on to work in many areas of the Latvian economy. There is not much direct collaboration with industry, although the remote sensing activity may in the longer term give rise to such interactions. The computing and IT research is apparently strongly connected to industrial partners, but the panel was given limited details because of cited commercial confidentiality. The institute is very international, particularly in astrophysics research, where many stakeholders attended the open meeting to testify to the value of their research collaborations with VUAS. The neuroscience activity within the IT unit is also very international.

Recommendations

- Draw up a long-term plan to rejuvenate the research staff in the astrophysics activity in the light of imminent retirements as a matter of urgency
- Strengthen the VUAS International Advisory Board by adding members drawn from well-known astronomers who do not collaborate with current VUAS staff
- On the basis of ISAB advice, decide on important areas of science on which to concentrate research effort and advertise positions accordingly
- Improve the management and planning of the unit, in particular the coherence of its component parts
- Establish in-house doctoral programme to exploit the world-class infrastructure and provide a dynamic cohort of PhD students and young researchers. If founding its own doctoral programme proves impractical, VUAS should associate itself closely with another university or universities that will provide a critical mass of young researchers sufficient to maximise the potential of the infrastructure
- Continue to improve the infrastructure in computing, particularly high-performance computing that is necessary both for IT and astrophysics research
- Seek urgent restoration of the maintenance funding for the radio-telescope installations and ensure new funding for necessary upgrades and continue telescope upgrades that are underway
- There is a considerable financial commitment required to keep the radio telescopes in the condition necessary to sustain EVN membership, which only makes sense for the long term. VUAS membership of EVN is only viable in the long term if the requisite (~ten years) funding can be found
- Continue to try to establish and exploit the possibility of funding streams through satellite communications, remote sensing etc
- Improve the social impact of the research, in particular the number of popular articles in the local press, TV and radio. Keep records of the breadth, depth and satisfaction engendered by all activities
- Improve the coherence and quality of the VUAS web presence, including YouTube
- Increase engagement with Latvian industry and develop commercial income streams

- Increase international visits and exchanges both to and from VUAS
- In summary the Panel recommends that VUAS develops a 5-year strategy that includes research and succession planning, skills development, improved management and options for financial models. This can then form the basis of an approach to the Ministry to support the strategy and a new financial model

N_7 Research programme "Mathematics, Physics, Chemistry", Daugavpils University

2.13 Institute Data and Description

The Daugavpils University research programme in the area of Mathematics, Physics and Chemistry is staffed by 16 staff members. The entity under assessment consists of four departments: the Department of Technology of DU. the Institute of Life Sciences and Technology, the Department of Physics and Mathematics and the Department of Chemistry and Geography. Research is carried out in chemistry, microscopy and mathematics with applications mainly in chemical and materials engineering and nanotechnology.

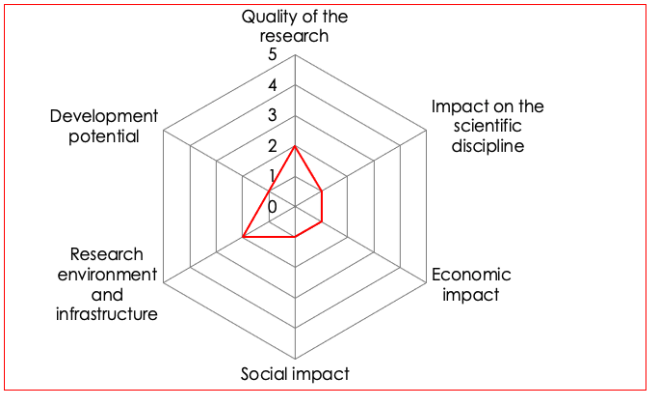
Daugavpils University Research programme "Mathematics, Physics, Chemistry"	
Primary field of research	i) Mathematics, ii) Physical sciences, iii) Chemical sciences
No. FTE academic personnel 2018	4.67
No. FTE academic research personnel 2018	11.4
Total number of FTE academic and research personnel 2018	16.07
Articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS in period 2013-2018	109
Articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS	23
Monographs in period 2013-2018	1
Patents Latvian in period 2013-2018	11
Patents (Europe and international) in period 2013-2018	0
Total no. of self-reported outputs in period 2013-2018	144
No. of WoS or Scopus outputs in period 2013-2018 per researcher in 2018	3.75
No. of all outputs in period 2018 per researcher in 2018	4.96
No of PhDs completed in period 2013-2018	3
No. of PhDs in period 2013-2018 per researcher in 2018	0.11
Total funding in period 2013 -2018 (Euros)	€ 10,972,351
Total funding in period 2013-2018 per researcher in 2018 (Euros)	€ 682,785

2.14 Expert panel evaluation

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

Figure 7 Research programme "Mathematics, Physics, Chemistry", Daugavpils University – Scores

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



Overall score

Score: 1

The Daugavpils University was founded in 1921 as a teachers' college. The transition to a regular university in which teaching is based on scientific research started some twenty years ago and the current state of the university still bears signs of its history. There is not a long tradition of high-level research.

The research programme in mathematics, physics, and chemistry at the university is characterised by a substantial heterogeneity and a lack of leadership. There are obvious opportunities for interdisciplinary research between these fields, but only few of them have been exploited.

On an international and even national level, the research is not particularly large in scale or ground-breaking and the results are mainly published in low-impact journals.

The entity is small and lacks critical mass for carrying out high-level research. In particular, the lack of post doc researchers is worrisome.

There is small-scale collaboration with local industry and enterprises, but the social and economic impact is rather meagre.

For the reasons mentioned above the overall score must be low.

Quality of Research

Score: 2 – adequate

The entity under assessment consists of four departments: the Department of Technology of DU. the Institute of Life Sciences and Technology, the Department of Physics and Mathematics and the Department of Chemistry and Geography.

Research is carried out in chemistry, microscopy and mathematics with applications mainly in chemical and materials engineering and nanotechnology. Interdisciplinary research in nanostructured materials plays a prominent role in the entity and the quality is of fairly good standard. The research in mathematics focuses on the theory of ordinary differential equations and dynamical systems. This is an active field of research in many top institutions worldwide, but the entity's contribution is not internationally remarkable. Recently, there have been a few applications to gene regulatory networks. In an international comparison this research is not particularly ground-breaking.

In the 2013 evaluation the panel advised the entity to publish more in international journals. To some extent they have succeeded in this, but most of their publication fora are low-impact journals. The lack of EU research funding is also a sign of lack of international recognition of the quality of the research.

The research at any department is to a large extent carried out by PhD students and post-doctoral researchers. Therefore, the quality of research of an institution usually strongly correlates with the success of the doctoral training and post-doctoral activities. While there has been a fair number of defended PhD dissertations, there has not been a single post-doctoral researcher in the period 2013-2018.

Impact on the scientific discipline

Score: 1

The impact of the research by the institution is rather low. With few exceptions the results are published in low-impact journals and the papers are not much cited. The international collaboration is mainly limited to neighbouring countries (Belarus, Russia, Lithuania and Ukraine). While this is understandable, it would be desirable to extend the international collaboration to other countries, too. Only one member of the staff has been invited to deliver lectures at international conferences. The entity does not report any conferences or workshops organized by it.

Economic impact

Score: 1

The entity has significantly increased its collaboration with industry and enterprises, in particular within the fields of materials and chemical engineering (e.g., holograms, biofuels), but there is no visible connection to the other research fields of the entity. It appears that these collaborations have not led to the companies supporting the entity financially in any significant way. During the period 2013-2018 the entity was awarded some Latvian, but no European or other international patents.

Social impact

Score: 1

A fair number of PhD students have been trained. There are plans for ensuring sustainability of the doctoral programme. This is important for the development of the region. The entity is involved in science communication and public engagement, but not to a large extent. There is a small number of contributions to non-scientific literature.

Research environment and infrastructure

Score: 2

The scientific equipment appears to be up to date and in good condition. However, in the virtual visit the entity expressed fear that they would not have sufficient funding to repair and maintain equipment in the future. The institute has made good use of EU Structural Funds with these funds representing 100% of the budget for infrastructure and institution development. On the downside the amount of money available from these funds decreased significantly over the reporting period. The national basic funding for research project represents on average 12% of the sum of basic and competitive research funding.

Concerning human resources, the entity is small (16.1 FTE of academic and research personnel in 2016). This means that critical mass is lacking in each discipline. However, on average the

personnel is rather young and master and doctoral students who are involved in the research form an important part of the research environment.

There are obvious possibilities of scientifically motivated collaboration between the departments. Because the entity is small, it should be easy to establish interdisciplinary collaboration. A more active leadership encouraging and facilitating cross-disciplinary research would enhance the research environment.

There is no tenure track system and professorships have to be renewed every six years. This is suboptimal.

There is no money to hire post-doctoral researchers. The research funding is usually earmarked for specific purposes and the rules for using the funding are too strict. This should be changed.

Development potential

Score: 1

The entity has expressed a vision to become internationally recognised in nanotechnology, material science, mathematical modelling with differential equations, the development of fluorescent compounds and luminophoric dyes as well as environmental quality assessment.

Based on the current activities, the small number of master and especially doctoral students and the very high dependence on external funds, the development potential of the institute is very limited. The state funding situation together with the decreasing amount of EU funds available have to be viewed as critical and potentially harmfully low resulting in the question how sustainable the funding situation of the institute will become in the upcoming years. The institute has so far not succeeded in stabilising its financial situation leading to problems with the sustainable financing of its staff. This has the potential to negatively influence its future development potential. This is especially true when looking at the urgently needed attraction of talented young researchers from universities who often prefer to develop their careers outside of Latvia. Without a continuous intake of these new researchers there is a substantial risk to lose competences when older researchers will retire.

The current lack of an active and strong leadership makes developments slow and difficult to realise. Advice given by a Scientific Advisory Board would help in this respect.

Potential to offer doctoral studies

The unit has equipment available needed for good PhD education, but lacks a sufficient number of senior scientists who could act as advisors. The salary a PhD student gets is very low. Students that are involved in externally funded projects are better paid. It does not seem purposeful that PhD students are paid differently for the same type of work.

Most students receive their master degree and PhD at the same university and the few post-doctoral researchers are also recruited internally. This scientific inbreeding is potentially harmful for the future development of the entity. Positions should be advertised internationally and good people recruited from all over the world.

Alignment with Smart Specialisation Strategy

Research is carried out in the fields of functional nanostructured materials, biosensorics, and fluorescent compounds for biomedical purposes. So, the entity's research is connected to the Smart Specialisation Strategy (Biomedicine, medical technologies, bio-pharmacy and biotechnologies, smart materials).

Conformity with state scientific and technology development

Research is carried out in the fields of complex hydrological, hydrochemical, hydrobiological and geomorphological research of the above-ground water bodies, scientific and applied research on the chemistry of renewable resources, application of environmental chemistry and bioindication methods in researches on the air quality and environmental pollution control, groundwater quality research and monitoring. So, the entity's research is connected to Climate change, nature protection, and the environment.

Recommendations

There is an urgent need for more resources for this entity. The equipment is fairly up to date and in good condition, but money is needed for hiring excellent people. If this is not provided, there is an obvious risk of further decline of the entity. The leadership and the collaboration between the departments in the entity have to be improved. The panel recommends that the decision-makers seriously consider the following suggestions.

- Establish a Scientific Advisory Board (SAB) consisting of internationally renowned scientists in the research fields of the entity. In particular, this SAB could give advice on leadership issues, prioritisation, establishing interdisciplinary links between the departments, development of PhD and post doc programmes and finishing the transition from a teachers' college to a regular university.
- Give the same salary to all PhD students independent of the funding source for the research activities.
- Establish a post-doctoral research programme and make sure it receives sufficient funding.
- Introduce a tenure track system. Once a professor has received tenure, he or she should not have to renew his or her professorship every six years.
- Actively recruit research personnel internationally at all levels.
- Make an investigation and prediction of the consequence of a decline and eventual cessation of EU Structural Funding and develop a detailed plan of how to respond to such a development.
- Research funding should not be strictly earmarked for specific purposes, but should be flexible enough to let the principal investigator decide about the use of money.

3 Summary of findings across the set of institutional evaluations

3.1. The process

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

The Natural Sciences panel consisted of six scientists, four of whom, including the chairman, were also members of the corresponding panel in the 2013 evaluation. Although the evaluated entities were not identical with those of the 2013 evaluation, this arrangement provided continuity and made it possible for the panel to assess the development of the Natural Sciences in Latvia during the past seven years.

Because of the covid-19 pandemic the panel could neither meet in person nor make site visits to the institutions to be evaluated. Although the online panel meetings and site visits worked well, they cannot be compared to real physical meetings with regard to information content. The panel therefore recommends that future evaluations be based on traditional meetings and site visits.

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

Each institution had produced a video presenting their infrastructure and giving other relevant information. These videos were available to the panel for scrutiny before the virtual site visits and served as an excellent starting point for the online discussions with the institutions. In general the videos were of high quality, both technically and content wise. Even if future evaluations are held in a more traditional way, institutions should still be asked to produce a video. The videos could with advantage be used by the institutions for promotional materials and would thus serve multiple purposes.

The virtual site visits had the following structure: They started with a meeting with the management and researchers of the institution followed by a meeting with the partners of the institution. Finally the panel had the opportunity to discuss with the doctoral students and post doctoral researchers without the presence of senior staff.

In the 2013 evaluation the Natural Sciences panel took the initiative to have a separate meeting with doctoral students at each site visit. As these meetings turned out to be very informative, the panel is pleased by the decision to implement such meetings for all panels in the current evaluation. However, in 2013 these meetings came as a surprise to the institutions and, as a consequence, the doctoral students spoke unprepared and freely about their research environments, the supervision they received, their salaries and job prospects. On the contrary, in the current evaluation the doctoral students and postdoctoral researchers were well prepared and in some cases appeared to convey the views of their superiors. Therefore, these meeting were less informative than the ad hoc meetings in 2013.

3.2. Main observations and recommendations

Although a positive development since the 2013 evaluation is clearly visible, many of the basic problems are still there. The main problem is the **lack of adequate basic fun**ding. Most of the institutions are still dependent on European Structural Funds. As this form of funding will inevitably decrease and eventually come to a cessation, **Latvia has to come up with alternative means for funding its research on a permanent basis**.

During the past seven years some institutions have increased their international activities, but by and large scientific collaboration and dissemination of results are still very domestically oriented. **The universities and research institutes should advertise open positions at all levels internationally. They should also actively recruit doctoral students, postdoctoral researchers and professors from abroad. Latvian scientists should be encouraged to acquire international experience. Such experience should be an important criterion for hiring professors.**

The panel learned that in many universities even senior researchers did not have tenured positions, but had to renew their professorships every six years. **The universities should introduce a tenure track system.** Once a professor has received tenure, he or she should not have to renew his or her professorship every six years.

The panel saw problems with the PhD education. Doctoral students have to undertake an extended coursework instead of concentrating on research. Students are also treated differently depending on whether they are involved in a project receiving external funding or not. This inequality also extends to salary. There is a considerably higher drop out rate among doctoral students not involved with projects receiving external funding.

The period after one has completed one's PhD thesis and before one has got a permanent or tenure track position at a university or research institute is extremely important in a young scientist's career. **Currently many institutions lack a post doctoral programme and a strategy for attracting bright young scientists.** Not enough resources are allocated to post docs. As a consequence, there are too few scientists employed at this career level. This may lead to a deficiency in skilful people to fill senior research positions in the future.

Appendix A Feedback on Panel assessment

Feedback received from the Institute of Solid State Physics

Institute of Solid State Physics, University of Latvia (ISSP UL) has carefully analysed the draft evaluation report issued by "Natural Sciences" expert panel organized by Technopolis group for "International Evaluation of Scientific Institution Activity, Latvia". First of all, we would like to express our appreciation for the in-depth analysis of our Institute's achievements, plans for future and development perspectives. In our opinion, the points given by the panel are well-argued and generally speaking are in line with our self-assessment. At the same time, we have an impression that the level of evaluation during this assessment has been higher than in 2013 and the panel has compared us to the (very) best public R&D institutions in Europe. We could definitely support this approach if the same level of stringency was applied in all the panels. Otherwise, the result of the evaluation exercise will not be objective and might send a wrong signal to the policy makers (Ministry of Education and Science, Ministry of Economics), politicians (Parliament) and general public.

For various reasons, the evaluation of our institute took place almost two years after the end of the official period under scope (1 January 2013 to 31 December 2018.). This causes some degree of uncertainty as to whether the panel has taken into account period up to the end of 2018, or up to the assessment moment at the end of 2020, or even a mixture of these periods. Many initiatives and projects that have been launched at ISSP UL in 2017-2018 have already beard fruits in 2019 and 2020.

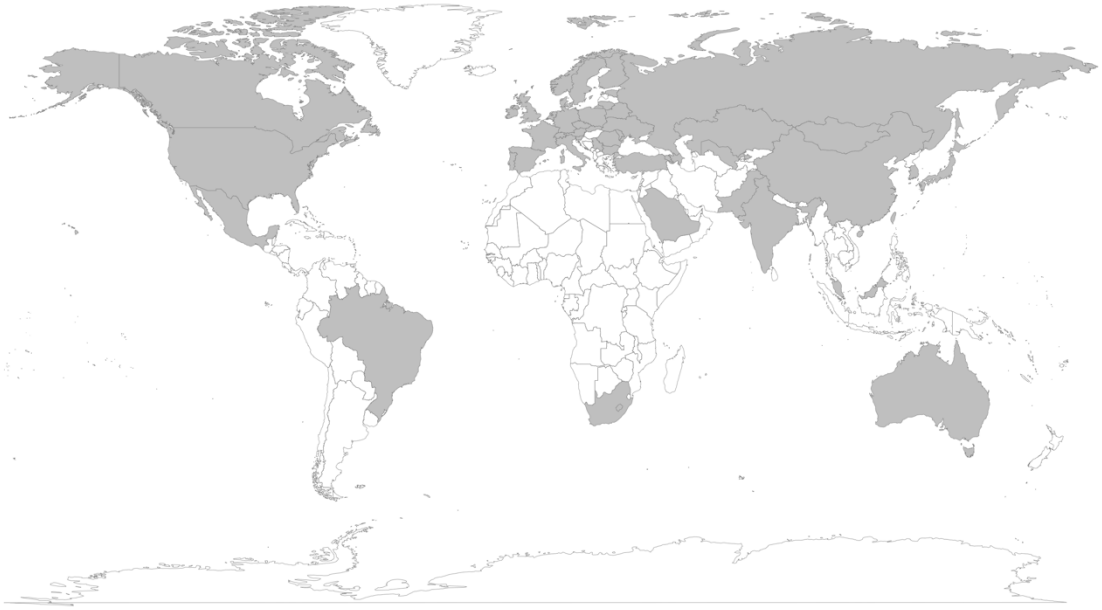
Comments on the Expert Panel Evaluation

We appreciate that the expert panel has objectively and in detail assessed the cluster for the given period based on the mandated criteria. The assessment provides fruitful comments for improving the coordination and functioning of research in the participating institutions. However, after analyzing the responses of the expert panel, we found that some important data were missed or misinterpreted, leading to, in our opinion, lower scores e.g., under the criteria “Research environment and infrastructure” and “Development potential”. We are sure that a face-to-face meeting and a real tour of the research environment and the infrastructure would have led to a clearer information about the cluster. Therefore, we wish to provide more detail on some points that results in a lower score than we consider to be justified.

Research environment and infrastructure

We find that a score “3”, which from methodology means "The institution is a strong national player. The institution is able to provide a research environment that is comparable with globally recognized academic institutions in its discipline.", is lower than we could understand from the justification "...indicate that the unit is well-organized, managed along with a proper strategy, and provides an attractive research environment." If the environment is attractive, then it is better than comparable. Moreover, one of the critiques is "Visiting researchers are, however, scarce, and efforts are needed to increase it", is not among the factors indicated to take into account this criterion. Full time equivalent of visiting researchers in the self-assessment report does not give the correct impression, as only the foreign researchers employed at UL are considered. Actually, recent years show a high number of visiting researchers (as shown in the table below, number of visiting researchers has declined in 2020 due to COVID-19 restrictions; map shows the origin countries of visiting researchers). Part of those visiting researchers have moved permanently to Latvia to work in the University of Latvia, e.g., Ulises Miranda Ordonez (Mexico), Teodora Kirova (Bulgaria), Roman Viter (Ukraine), Viktoriia Fedorenko (Ukraine), Blaž Cugmas (Slovenia), Mindaugas Tamošiūnas (Lithuania), Abuzer Yakaryilmaz (Turkey), Raqueline Azeveido Medeiros Santos (Brasil), Kiryl Niherysh (Belarus), Andrei Felsharuk (Belarus), Yelysaveta Rublova (Ukraine), and others.

	2013	2014	2015	2016	2017	2018	2019	2020
Number of visiting researchers (Number of countries)	46 (17)	91 (23)	81 (23)	91 (21)	72 (23)	104 (29)	73 (23)	51 (17)



Furthermore, active international collaboration is an indicator that the infrastructure of the cluster is intensively used and allows to develop the top-level international research. Of course, this could be improved further, but at least partially this is a funding issue, which is already criticized in Criterion E. It is difficult for us to agree with the argument "The presence of low-performance groups, however, introduce a weak point, providing examples not to follow" because it was not possible to draw such a conclusion from the self-assessment report, where it was not possible to include information on each group due to size constraints. We agree with the conclusion that there are differences between scientific groups, but there are no weak groups in the cluster.

Development potential

We consider that result "3" is not appropriate and may have been given due to limited extent of data analysis in our self-assessment report. European Fund of Regional development is only one of several funding sources (33.9% from the total Competitive research projects funding in the period 2013-2020), but by far, the research in Natural sciences at the University of Latvia does not "... depend heavily... "on this funding source. The table below shows the amount and percentage of the total competitive research projects funding at NSC-UL. Moreover, ERDF is currently a notable part of the research funding provided by the Ministry

of Education and Science in the Latvian research environment. Blaming NSC-UL for being dependent on it, when this is forced by the research funding policy in Latvia, while the cluster has been very successful in attracting it in open competitions, would not be right. Especially, as NSC-UL has been successfully working also on other sources of funding, as already acknowledged.

	2013	2014	2015	2016	2017	2018	2019	2020
Competitive research projects (euro)	**5 991 709 (100%)**	**6 460 239 (100%)**	**5 789 242 (100%)**	**3 579 024 (100%)**	**7 646 394 (100%)**	**11 666 076 (100%)**	**8 548 005 (100%)**	**12 588 702 (100%)**
1. EU structural funds budget	2 028 808 (33.9%)	3 146 743 (48.7%)	2 773 021 (47.9%)	497 128 (13.9%)	3 769 551 (49.3%)	4 648 916 (39.8%)	3 618 833 (42.3%)	4 048 675 (32.2%)
1.1. EAFRD	*0 (0.0%)*	*0 (0.0%)*	*0 (0.0%)*	*0 (0.0%)*	*0 (0.0%)*	*8 461 (0.1%)*	*75 824 (0.9%)*	*44 451 (0.4%)*
1.2. ERDF	*896 014 (15.0%)*	*2 143 154 (33.2%)*	*1 914 598 (33.1%)*	*218 366 (6.1%)*	*3 769 551 (49.3%)*	*4 640 455 (39.7%)*	*3 543 008 (41.4%)*	*4 004 224 (31.9%)*
1.3. ESF	*1 132 794 (18.9%)*	*1 003 589 (15.5%)*	*858 423 (14.8%)*	*278 762 (7.8%)*	*0 (0.0%)*	*0 (0.0%)*	*0 (0.0%)*	*0 (0.0%)*
2. Other international sources of finances	295 584 (4.9%)	350 146 (5.4%)	406 702 (7.0%)	443 767 (12.4%)	564 749 (7.4%)	423 442 (3.6%)	723 033 (8.5%)	1 438 533 (11.5%)
3. Other national sources of finances	684 863 (11.4%)	534 238 (8.3%)	1 078 723 (18.6%)	765 579 (21.4%)	1 316 877 (17.2%)	1 670 438 (14.3%)	1 713 313 (20.0%)	2 729 161 (21.7%)
4. State budget funding	583 119 (9.7%)	809 165 (12.5%)	952 784 (16.5%)	1 215 854 (34.0%)	939 114 (12.3%)	1 739 397 (14.9%)	2 042 881 (23.9%)	2 735 099 (21.8%)
5. EU Framework Programmes' budget	2 399 335 (40.0%)	1 619 948 (25.1%)	578 011 (10.0%)	656 696 (18.3%)	1 056 103 (13.8%)	3 183 884 (27.3%)	449 945 (5.3%)	1 607 233 (12.8%)

The other critique concerns the declining number of Master and PhD thesis. For master students, it is important to view this with respect to the demographics of Latvia. The number of people born in Latvia in 1989 (to graduate MSc ~2013) was ~40'000, while people born in 1994 (to graduate MSc ~2018) were ~25'000, which is a decrease by almost 40% and in the next years decreased even further to ~20'000 children. The decrease in the number of MSc graduates in identical period is similar, but smaller. As shown in table below the number of MSc graduates of NSC-UL and in whole Latvia declines in similar trend and NSC-UL still provides more than 12.5% of all MSc graduates of academic programs. It is worth to mention that the national legislation currently limits the ability to attract international master students, also limiting the ways in having a larger number of students.

	2013	2014	2015	2016	2017	2018	2019
Completed their Master degree (NSC-UL)	258	215	212	195	183	147	147

Completed academic Master degree in Latvia (total)[1,2]	1731	1688	1490	1411	1362	1179	1151
Share of NSC-UL completed Master degrees	14.9%	12.7%	14.2%	13.8%	13.4%	12.5%	12.8%
Defended doctoral dissertations (NSC-UL)	43	40	55	23	13	25	26
Defended doctoral dissertation in Latvia	315	266	263	197	151	123	134
Share of NSC-UL defended dissertations	13.7%	15.0%	20.9%	11.7%	8.6%	20.3%	19.4%

A similar situation is with PhD students, where an additional external factor in the increase of graduates in years 2013-2015 was a temporary PhD scholarship scheme (finished in 2015) organised by Ministry of Education and Science and financed by European Social Fund project, which required its holders to graduate at the latest by 2015. Since then, the enrolment of PhD students has not decreased, while the lack of targeted funding support prolongs the time needed to prepare Theses. Therefore, we consider that it is not correct to assume that the interest of students is lacking. Also, the FTE of research assistants and researchers is increasing steadily, where a large portion of those are PhD students or doctoral degree candidates. In fact, the decrease in the number of defended PhD thesis indicates that there are multiple doctoral degree candidates in the system that should graduate soon. Several incentives help this to happen, including the restructuring of PhD programs.

We do not want to agree with the evaluators statement “The PhD program is currently being restructured with the aim of establishing doctoral schools” as already now in the cluster are actively functioning 5 doctoral schools, and the plans include harmonization of their activities with the aim of promoting interdisciplinary cooperation and organizing joint courses for doctoral students.

Economic impact

The main economic impact of the cluster is in the training of highly qualified experts in fields of chemistry, biology, physics, IT, computer sciences and in several areas the University of Latvia is the only one institution in Latvia, which is training graduates in the respective field, e.g., geoinformatics, geology etc. Our graduates are competitive not only in the labor market in Latvia but also internationally. However, the UL cluster has also a direct and significant impact on the economy, as indicated by the contract research activities in Latvia as well as

[1] https://www.izm.gov.lv/sites/izm/files/augstakas_izglitibas_lv_parskats_20181.pdf

[2] https://www.izm.gov.lv/lv/media/2125/download

internationally. Considering this, the score of the cluster “3” – is lower than we could understand from the missing arguments, and we are asking to reconsider it.

Overall score

We feel that the given overall evaluation and score is not inappropriate.

The question of choosing the units for evaluation reflects the university's strategy for closer interdisciplinary cooperation between the faculties of natural sciences and scientific institutes and the planned structural integration in the future.

In many leading foreign universities, often units in natural sciences are combined in one faculty, so there we do not understand expert's skepticism about the viability of such a cluster. Besides questioning the presentation of the cluster, experts noted problems in management. Structural units of the cluster, although somewhat independent, in their scientific and teaching activities are managed by Vice-rector **for Natural Sciences, Technology and Medicine.**

In the field of Natural sciences, there are 5 faculties (Faculty of Biology, Faculty of Chemistry, Faculty of Computer Science, Faculty of Geography and Earth Sciences and Faculty of Physics, Mathematics and Optometry) where the research groups often collaborate. For example, the teaching staff of the Department of Physics at the Faculty of Physics, Mathematics and Optometry is also affiliated with four different the Institute of Physics, Institute of Atomic Physics and Spectroscopy, Institute of Chemical Physics, Institute of Material Mechanics, while researchers in this faculty also collaborate with academics in the Faculty of Computer Science, Faculty of Geography and Earth Sciences, Institute of Microbiology and Biotechnology. Also, the Faculty of Chemistry has teaching staff affiliated with the Institute of Chemical Physics. Similarly, the Faculty of Geography and Earth Sciences has joint research projects with academics in the Faculty of Biology and Faculty of Chemistry. The Faculty of Computer Sciences also collaborates with the Faculty of Biology, etc.

It would be important to stress that after the previous evaluation (the units of this cluster were evaluated as 14 different entities) of the University of Latvia research performance, all research groups, which received evaluation “2” was reorganized or closed, but in case of evaluation “3” – major restructuring took place. Further regular monitoring of research performance of the UL NSC participants is going on to boost the research output.

We are thankful for the suggestions and recommendations and hope, the found misunderstandings in the evaluation will be corrected.

Prof. Valdis Segliņš

Vice-Rector for Natural Sciences, Technology and Medicine

Ventspils University of Applied Sciences' comments regarding the international assessment of the Natural Sciences Research Platform

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

Overall score:

REPORT: *"...(VUAS) has a strong research programme, mostly of national importance with some areas of international importance, particularly in astrophysics. Its radio telescope infrastructure is of international importance"*

This evaluation does not show the overall impact of membership of international consortia, in particular **JIV-ERIC (not mentioned at all in this evaluation)**, which plays a fundamental role in VUAS's scientific excellence, existence and overall development.

Thanks to previous scientific achievements and the technical level of radio astronomical equipment, Latvia has been admitted as a country to the European Union astronomical radio interferometry organization **JIV-ERIC**. This is a state of honor, as the other members of JIV-ERIC are France, Netherlands, Spain, Sweden and the United Kingdom (*http://jive.eu/jive-partners*). Several other European countries (Germany, Italy, Finland), which also have advanced radio astronomy and radio interferometry, are not yet members of JIV-ERIC. From this year, Italy will be part of JIV-ERIC. VUAS with two radio telescopes is a full member of **EVN** starting from 2016 as well (*https://www.evlbi.org/contact*). In the time period from 2012 to 2015, multimillion infrastructure investments were made, as a result of which two radio telescopes were completely refurbished and fitted with state-of-art equipment. Also, during this period, corresponding engineering and scientific groups were formed. These teams provide appropriate support and open for World radio astronomical community access to the high level radio astronomical observations on VIRAC radio telescopes.

In the autumn of 2019, the LOFAR low-frequency radio telescope was put into operation at the VUAS, which immediately became part of the European international network **"International LOFAR Telescope" (ILT)** with a center in the Netherlands (*https://www.astron.nl/agreement-signed-for-lofar-station-in-latvia/*). Regular observations are carried out within the ILT in accordance with the common network program, but independent observations in the single station mode, first of all solar observations, are gradually being launched. In the near future, in cooperation with partners, it is planned to launch research on the ionized hydrogen regions of massive stars and interstellar environments, and the first applications for the use of the entire ILT network for the benefit of VUAS scientists are already being submitted. Starting from 2022 ILT will be transformed into a **LOFAR-ERIC** consortium and this means that Latvia will already participate in two leading international radio astronomy ERIC consortia. During the time period evaluated, the necessary international preparatory work was performed and in 2017 the construction of the station was started.

Assessment criterion "Quality of research"

REPORT: "*...solar physics and radiative transfer, are only of national significance*".

We would like to oppose this opinion, because our publications in these fields have appeared in prestigious refereed journals and have been referenced by foreign scientists.

The recent review on radio magnetography in the solar atmosphere "Radio Measurements of the Magnetic Field in the Solar Chromosphere and the Corona" by

C.E.Alissandrakis and D.E.Gary refers to the solar group members by 9 out of 157 publications (https://www.frontiersin.org /articles/10.3389/fspas.2020.591075/full). This can evidence for the general international significance of the investigations in this field. Our papers are published in the world's top specialised journal, "Solar Physics".

As for the pioneering research of the sunspot atmosphere, it was shown for the first time that some sunspots are the sources of slow solar wind (solar-related space weather). That is why "Solar Physics" journal selected our article for the special collection "Towards Future Research on Space Weather Drivers" (https://link.springer.com/journal/11207/topicalCollection/AC_f1f9c8d342762dea9df8348a158ace94) to promote further investigations on this theme.

Summarizing, we think our solar physics research has international significance.

Discussing research in radiative transfer theory, all our key papers have been published in the world's top journal on this topic, "Journal of Quantitative Spectroscopy & Radiative Transfer" (JQSRT). To our mind, this fact proves the international significance of the research. The last paper in JQSRT was published in the beginning of 2019 but the scientific results were obtained fully during the period of evaluation.

Assessment criterion "Social impact"

REPORT: "*Although mention is made of various activities, including the role of the radio telescopes as an attractor for young people, few details are given.* "

To give more details, VIRAC telescopes have attracted thousands of visitors in the 2013-2018 period, and the entrance fees have been one of the few independent funding sources. A specific visitors` centre is in development, separate from the working scientific installations and including, for example, the old engines of the telescope and the old dish of RT-16. No fewer than 30 of popular scientific texts have been published, often in Latvia's popular astronomy journal "Starry Sky".

Assessment criterion "Research environment and infrastructure"

REPORT: "*Coherent planning for the unit overall, as well as for astrophysics in particular, seems to be lacking. Each of the major fields of study has a particular niche and potential, but how they complement each other and how to strengthen the position of the VUAS on the national and international scene is not clear from the self-assessment report.*"

The diversity of the topics of our astrophysical research is not big, and there are complementarities. These have been demonstrated by trans-topic projects (see comment on projects below). There are two broad astrophysics fields - the Solar system and the interstellar medium, each of which has theoretical and observational research aspects.

In solar physics, we have three doctors, two of whom (B.Ryabov and A.Vrublevskis) are mostly theoreticians, and D.Bezrukovs is predominantly an observer using RT-32. A.Vrublevskis will presumably be the principal observer using LOFAR. These three doctors work in close contact. Note that B.Ryabov who is an undoubted leader of our solar physics group is at the age of retirement, and the current principal observer, D.Bezrukovs, is also at the age of retirement.

Another most important direction is the physics and chemistry of the interstellar medium. There is a clear complementarity between research in theoretical astrochemistry by Dr. J.Kalvāns and Dr. A.Vasyunin, from one side, and the observations of interstellar molecular lines (Dr. I.Shmeld, age of retirement, and his PhD student A.Aberfelds) on the other side. Research in radiative transfer theory by Dr. J.Freimanis (age of retirement) is more remotely connected with this but in recent years he has just started theoretical studies of circumstellar

envelopes, ensuring scientific leadership for one of our talented young researchers, R.Peženkovs. Research on circumstellar envelopes has close connections with astrochemistry and molecular line observations. Both research fields include other students and PhDs.

REPORT: "*Coherent planning for the unit overall, as well as for astrophysics in particular, seems to be lacking. Each of the major fields of study has a particular niche and potential, but how they complement each other and how to strengthen the position of the VUAS on the national and international scene is not clear from the self-assessment report.*"

The diversity in astrophysics research has been well used to create successful trans-topic projects, such as "Physics and chemistry of the interstellar medium" (ASTRA) and "Evolution of Organic Matter in the Regions of Star and Planet Formation (OMG)". The ASTRA project (2017-2020; 624 kEUR) combined observations of galactic masers with VIRAC telescopes, radiation transfer (adding the expertise of solar physicists), and astrochemistry, while OMG (2018-2021; 300 kEUR) combines astrochemistry and maser observations. This funding is similar to that obtained by astronomy projects considering a single, narrow field of research. Thus, the diversity of VIRAC astrophysics research has been employed to obtain funding and has been actually beneficial in the 2013-2018 period.

Assessment criterion "Development potential"

REPORT: "*The panel found it difficult to understand why the researchers are heavily overloaded by teaching, but the number of students is relatively low.*"

VIRAC is a part of VUAS, which performs both research and studies. Only about 30% of VIRAC's researchers teach VUAS IT and electronics engineering students. However, study work helps to attract students as programmers and engineers for joint research in engineering and natural sciences. Most of our excellent engineer corps have been home-grown.

REPORT: "*This plan should address how to attract world-class scientists from outside Latvia, who would find the remarkable VUAS infrastructure attractive and who would increase the output of world-class research papers.*"

Theoretically a correct recommendation, but really almost impossible to implement (see above). We had a European - funded EraChair project (LATSPACE) where European level of salaries was offered for senior scientists attracted from abroad. The ad-hoc International Selection Committee evaluated the applicants as too weak for the position of senior scientist. For now, we are obliged to focus on the existing researchers' abilities and expertise.

REPORT: "*The development of this plan requires the formation of a prestigious International Scientific Advisory Board, whose members should be drawn from well-known scientists who do not collaborate with current VUAS staff in order to ensure independent advice. This committee should continue to give advice on VUAS's direction beyond the implementation of this plan.*"

The International Advisory Board of VUAS was established in 2015. The Board was established to provide opinions and advises in the development of the Research program of VUAS, as well as to advise the management of the VUAS on the organization of scientific activities. The members of the International Advisory Board of VUAS:

- Leonid Gurvits – JIV-ERIC leading researcher;
- Dainis Draviņš – Lund University, The Royal Swedish Academy of Sciences (Sweden);
- Georges Zissis – The University of Toulouse**;** "IEEE Industry Application Society" (France);
- Gunter Werth – University of Mainz (Germany);

- Justin Bancroft – Deloitte & Touch international consultant (USA);
- Julie Felker – University of Michigan (USA);
- Ulrike Haß – University of Duisburg-Essen (Germany);
- Klaus Schubert – University of Hildesheim (Germany).

Recommendations

REPORT: "*There is a considerable financial commitment required to keep the radio telescopes in the condition necessary to sustain EVN membership, which only makes sense for the long term; VUAS should only commit to EVN membership if it is assured that the requisite long-term (~ten years) funding can be found.*"

VUAS is a full member of EVN starting from 2016 already. We fully agree with the opinion of the experts that the requisite long-term funding for VIRAC's radio telescopes must be provided to keep the radio telescopes in the condition necessary to sustain EVN membership.

Feedback received from Daugavpils University research programme "Mathematics, physics and chemistry"

About international evaluation report of scientific institutions of the Daugavpils University research programme "Mathematics, physics and chemistry"

Quality of Research

Experts confirm that in comparison with previous evaluation the progress has been achieved, however most of publication fora are low impact journals. The mentioned aspect is hardly explainable because the quotability of scientists has been significantly increased since 2013 (for example, Ē.Sļedevskis – 6 times, V.Gerbreders – 4 times, WoS data).

We would like to mention that the meaning of journal's quartile was not clear to the experts, and the online meeting time had partly been spent on its explanation. Therefore, the experts' comprehension of the mentioned by them term "low impact journal" stays unclear for us. We suppose it is important to add that the experts publish their research in the same journals as our scientists do (for example, [1] and [2]; [3] and [4]).

The experts mention the "fair" defended dissertations, where the lack of post-doctoral programmes has been indicated as the main disadvantage. We suppose that the mentioned aspect is not our department's competence. The lack of such kind of programmes represents a problem at the national level. We would like to emphasize that currently the researchers of our department realize two post-doctoral grants.

Impact on the scientific discipline

The low level of journals and low quotability has been mentioned once again, however the results have been significantly improved in comparison with previous evaluation (that was also confirmed by the experts). Therefore, the present evaluation does not seem fair both to the previous evaluation and in comparison with other departments. Cooperation mainly with neighbouring countries has been indicated as another disadvantage, that is also disputable: this was the only possible and the most effective solution to enlarge the international cooperation relations in our economic situation. The presentation contained much more information on the international cooperation all over the world that had not been taken into consideration at all.

Economic impact

The fact that the department has significantly improved cooperation with the industry has been mentioned by the experts, however its evaluation is significantly lower in comparison with the previous one, that stays hardly explainable.

Social impact

The number of prepared PhD students has been indicated as "fair". The evaluation is negative and hardly to be explained. We ask to compere the mentioned rate with the achievements of other structural units – the number of prepared doctors by the number of staff.

Research environment and infrastructure

The experts have mentioned a good infrastructure, but during a visual visit the lack of finances to manage it has been indicated. It is hardly to understand the way the experts managed to state the mentioned aspect without visiting the university personally and asking any questions on it.

It should be emphasized that the infrastructure video's shortness and its musical accompaniment have been mentioned as the main disadvantages.

Development potential
The dependence on the outside financial support has been mentioned as the main disadvantage. However, it is not only our department's problem, and therefore we suppose it as unfair reference both in comparison with previous evaluation and with other structural units.

Potential to offer doctoral studies
A low salary of doctoral candidates has been mentioned as disadvantage. But this is not our structural unit's competence as well. The next disadvantage indicated by the experts has been the fact that doctoral students' body is represented mainly by our master's students, but their significant foreign experience in frames of ERASMUS+ programme has not been taken into consideration.

It should be mentioned that the experts have demonstrated total disorientation in Latvian science, aspects of educational organisation and situation as such. We had to explain plenty of similar questions during the meeting, spending the planned for the meeting time. The lack of comprehension has been fully demonstrated in the received recommendations – almost all recommendations refer to the level of Ministry of Education, legislation or bigger structural units (university or institute), for example: "Introduce a tenure track system. Once a professor has received tenure, he or she should not have to renew his or her professorship every six years", "Give the same salary to all PhD students independent of the funding source for the research activities", "Establish a post-doctoral research programme and make sure it receives sufficient funding", "Research funding should not be strictly earmarked for specific purposes, but should be flexible enough to let the principal investigator decide about the use of money", etc.
Taking into consideration the all mentioned before, we ask to review the evaluation of our direction by the commission, knowing the Latvian science and education system, as well as the situation in the field.
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