Lithuania: Research Assessment Exercise

Panel P: Physical Sciences

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Lithuania: Research Assessment Exercise

Panel P: Physical Sciences

MOSTA, March 2015

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Introduction

Background

The overall objective of the research assessment exercise of the Lithuanian Higher Education and Research Institutions was:

To provide the Lithuanian public, policy-makers and decision-makers and the academic community with the most objective picture possible of the excellence and competitiveness of Lithuanian science in comparison with global practice in the respective area of science.

The assessment produced evidence based analytical material that carefully and in details analyses the research excellence and competitiveness of Lithuanian research, whilst also considering its socioeconomic impact and the capacity of its research institutions. This material will provide evidence for research policy making at different levels as well as enabling the research institutions involved in the process to gain a significant impetus for improving their activities. The research assessment was directed at institutions that were Higher Education institutions and their constituent faculties/departments/research groups or State research institutes.

Altogether nine panels were appointed to perform the evaluation. This document is the report of Panel P: Physical Sciences.

Scope of Panel P: Physical Sciences

The Panel were asked to evaluate research in Physical Sciences in 19 Units of Assessment (UoA) using the following criteria: research quality, economic and social impact, infrastructure, research management and development potential and to score each Unit on a five point scale, namely, ranging from outstanding [5] to poor [1]. The overall objective was to benchmark research in Lithuania against international research in the Physical Sciences.

Material on which the assessment was based

Each unit participating in the evaluation provided the panel with a self-assessment report for the years 2009 - 2013. The self-assessment report contained the following categories:

1. General information about the unit of assessment (UoA)
2. Human resources
3. Research output
4. Doctoral training
5. National and international collaboration
6. Other scientific and social activities
7. SWOT analysis
8. Funding

The self-assessment also included a list of best publications which were sent to the panellists. The panel also had access to a bibliometric analysis including information on citations and international co-authors.

Assessment procedure

Experts from Panel P visited Lithuania on January 19 – 23, 2015 and during this period they made site-visits to all UoA. The final Panel P assessments were based on both, the self-assessment reports and evidence gathered during site visits. At least two panel members were present at each visit. Each self-assessment

report was read in details by at least two Panel members and then discussed by the whole Panel on at least two occasions, namely, before and after the Panel visits to the Units.

Institutions involved

Panel P was asked to evaluate 19 UoA within 7 institutions. The scientific disciplines of these institutions include Environmental Engineering, Mathematics, Physics, Chemistry, Biochemistry, Biology, Geology, Geography, Astronomy, Informatics, Ecology and Environmental. The institutions were as follows:

Universities

1. Kaunas University of Technology
2. Lithuanian University of Educational Sciences
3. Vytautas Magnus University
4. Šiauliai University
5. Vilnius University

Research Institutes

1. Center for Physical Sciences and Technology
2. Nature Research Centre

Summary of the overarching comments

Summary

The Units were very diverse in their range of activities and in most cases spanned a number of research topics, this range of topics complicated the assessment in comparison to single subject assessment as there was great variation in the research activities and contributions within many Units. However the Panel carried out the assessment according to the above criteria. As a result within many Units some research scored highly while other research did not resulting in a lower overall score for the Unit. The Panel have tried to identify such situations within the individual comments for a particular Unit and to make appropriate recommendations.

The Panel found the number of Units to be too large and the cooperation between Units not as good as it should be. The Panel recommend that detailed discussions between similar Units and topics should take place based on the criteria of reducing duplication and/or merging as much as possible in order to focus the national research effort. In addition, the structure within Units should be as flexible as possible and not tied to historical legacies in order to facilitate focus on international research promotion.

The Panel assessed that 5 Units were operating at the grade 4 level indicating strong international players and in the Panel's opinion these Units are functioning well and are capable of continuing research and increasing their impact internationally.

The Panel assessed that 9 Units were operating at the grade 3 level indicating strong national players with some international recognition but they do have some shortcomings against the assessment criteria which need to be addressed to increase their international impact.

The remaining 5 Units were assessed at the grade 2 level indicating satisfactory national players and therefore need major examination and/or change for their future operation to be at the international level.

Specifically the Panel recommend that some Units which appear to have complementary activities be considered for merger, namely:

- The Faculty of Mathematics and Informatics (Vilnius University) and the Institute of Mathematics and Informatics (Vilnius University),
- The Institute of Geology and Geography (Nature Research Center) and the Geo Faculty of Natural Sciences (Vilnius University),
- The Institute of Biotechnology (Vilnius University) [lead] and Institute of Biochemistry (Vilnius University)
- The Faculty of Chemistry (Vilnius University) [lead] and the Institute of Chemistry (Center for Physical Sciences and Technology).

The Panel would like to express their thanks to all the members of the Units - both staff and students - that they met and very appreciate their input and comments which they found very helpful.

National research funding

The Panel recommend that all public research and development funding in Lithuania is allocated using assessment by international panels of experts as the research base in Lithuania is too small to carry out this task to ensure international standards are applied.

University funding

The Panel observed that the core government funding has been erratic and is insufficient to fund university research activities at the international level. There has been some success in the Units in terms of EU funding but there is a need to distinguish between funding received from the competitive Framework research programmes and the European Regional Development Fund programme, which mainly supports infrastructures and equipment. The Panel recommends that all Units should become more involved at the European level and aim to be part of future programmes such as Horizon 2020.

Bureaucracy

The Panel received many complaints about Lithuania bureaucracy and although the Panel recognise that throughout the scientific community there has been an increase in administration there does appear to be excessive bureaucracy in the Lithuania scientific funding system, for example, many researchers were giving this as a reason for not applying for research grants. The Panel recommend that Lithuanian bureaucracy, particularly for procurement, is made as simple and flexible as possible.

PhD students

The Panel were impressed by the PhD students who they talked with across the Units and also with the level of supervision that was being received by the students; supervisors were readily accessible and the Panel did not hear a single complaint while talking with several hundred PhD students. All students showed evidence of high international mobility through participation at conferences and internships. The students that are studying in Units not belonging to Universities sometimes don't have access to all journals: something should be done at the national level.

The Panel recommend that the level of PhD scholarship should be increased to a level that enables students to concentrate on their PhD studies alone without the need to take another position to supplement their income; this latter activity should be discouraged. This, in turn, should reduce the time to complete a PhD in Lithuania which at the present time is too long; 5 years was given as normal while elsewhere the time is usually less. The policy of Kaunas University of Technology in requiring students to take at least one semester/course abroad is something which the Panel feel should be implemented for all PhD students across Lithuanian in the Physical Sciences.

The Panel recommend that the number of PhD scholarships is increased as PhD students are the future of research in Lithuania.

Postdoctoral Fellows

The Panel was surprised by the few number of Postdoctoral Fellows they met during their visits. The Panel recommend that the Postdoctoral Fellows Programme is aggressively promoted in particular to facilitate inward visits from the international research community.

Researchers

All researchers were technically well qualified and often performed highly skilled research. A recurring problem was their work in more than one position, often within closely allied institutes/faculties. This creates problems of allegiance and made a clear assessment of their individual contributions to one Unit problematic. In many cases researchers showed no ambition and motivation despite often excellent working conditions. Examples for positive professional development were found more in the smaller, under-funded Units than in the larger ones.

Age distribution

There is an age distribution problem in some Units where the majority of the managers/researchers are in the upper age bracket. The Panel recommend that Units be encouraged to ensure that career promotion and research management processes are made available to all staff and that a policy of management rotation be developed in those Units with managers in the upper age bracket.

Working language

The use of the Lithuanian language is perceived as an impediment to attracting non Lithuanians to study or research in the country. The Panel found many cases where the working language within Units/laboratories was Lithuanian and where many, if not, all signs were in Lithuanian. Lithuania research Units need to get across the message to the international community that if researchers go to Lithuania they will find a working environment which they can readily adapt to and that the day to day working is in the international scientific language, English. The Panel recommend that all students should be required to do all their work in English; course work, written work laboratory notebooks and project work.

International involvement

The Panel identified two areas of concerns about many of the Units that they visited, namely, a lack of ambition among the staff and a lack of leadership. Many researchers regarded the Baltic States or nearby geographical area as their main area of competition rather than the USA, Germany etc. as the main area of competition and where they should be focussing their challenges. The Panel also observed a lack of initiative/leadership, many researchers had made substantial contributions within their research field but the Panel found little evidence that they had initiated research projects as would be evidenced by, for example, being the principal investigator of an EU framework project. The Panel recommend that incentives/support should be introduced for researchers which reward ambitious and more proactive activity in promoting their research through international channels and, in addition, consider linking national and international funding.

Sabbatical Leave

The Panel recommend that sabbatical leave with salary be encouraged in order to promote more international participation by Lithuanian researchers. A clear tenure track career progression would also aid in the recruitment of (inter)national scientists.

Equipment

In general the Panel found state of the art equipment available in many Units most of which resulted from the establishment of the ‘Valleys’ initiative. There is a requirement that the equipment is exploited to its best

potential and the Panel recommend that sufficient technical support staff and recurring costs are made available.

There were some disturbing instances where the Panel discovered PhD students using their own equipment for their PhD studies which is unacceptable. Library provision was found to be satisfactory and was greatly assisted by the widespread introduction of electronic libraries and databases.

Technology transfer

The Panel found many good examples of technology transfer and applied research; much of this activity relies on the maintenance and operation of the existing equipment. The Panel recommend that researchers in this area should be assessed and promoted on the impact of their research rather than the normal publication criteria. Often the Units did not capitalize on their technology transfer skills. However, a clear distinction between simple service contract research at the laboratory technician level and impact driven applied contract research should be made.

In summary,

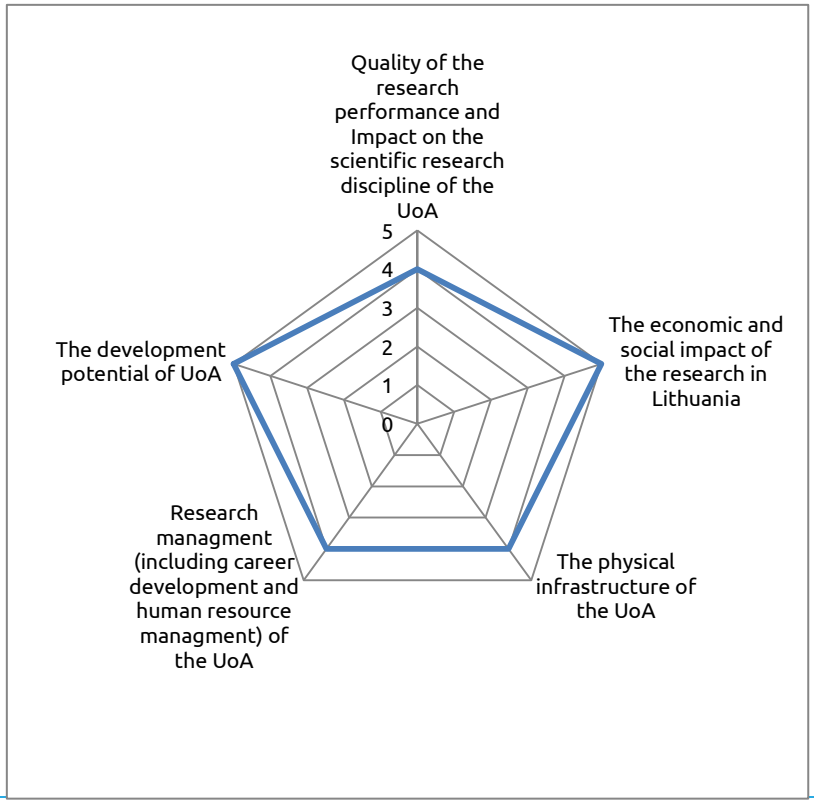
i) there is a good PhD student base which needs to be expanded which subsequently could consolidate the future of Lithuania international research,
ii) there is a substantial base of modern equipment in the country to facilitate international research but there is a need to ensure continual maintenance and support,
iii) there are many instances of international research being performed however there are many cases where this research is not being exploited and promoted internationally,
iv) as many courses as possible should be lectured in English as this will help universities to attract more foreign students and staff.

Assessment of the Unit

Optoelectronics and laser technologies, Center for Physical Sciences and Technology

Name of the UoA	Optoelectronics and laser technologies
Name of institution being assessed	Center for Physical Sciences and Technology
Total no. FTE researchers	63,6
Composition of the Unit of Assessment (UoA)	DEPARTMENT OF OPTOELECTRONICS; DEPARTMENT OF LASER TECHNOLOGIES

Quality of the research performance and Impact on the scientific research discipline of the UoA	4
The economic and social impact of the research in Lithuania	5
The physical infrastructure of the UoA	4
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	5
OVERALL SCORE	4



OVERALL SCORE

In view of the grades obtained for the quality of the research, the economic and social impact, the physical infrastructures, the research management and the development potential, the panel believes that Optoelectronics and laser technologies is the best unit among the ones reviewed.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit consists of 2 Departments: OPTOELECTRONICS and LASER TECHNOLOGIES. The main objectives are: fundamental research of light interaction with materials, development of laser, photonic, and optoelectronic technologies and implementing them in Lithuanian high technology enterprises. There are in Lithuania numerous companies active in the fields of laser and optoelectronics industry and this is a priority area for the country. In fact, the Department of Laser Technologies was established in 2004 as an application laboratory of the EKSPLA laser company (located next to the Department). The Unit is using MBE technology for the research and fabrication of various electronic and optoelectronic devices: IR lasers, light emitting diodes, photodetectors, terahertz emitters and detectors. Actually, efforts are done on the epitaxial growth of dilute bismide compounds on GaAs, GaSb, and InP substrates as well as the development of bismide based optoelectronic devices: the laboratory is one of the leaders in that area. It is also at the front

edge of surface THz emitters and optoelectronic components for THz systems activated by long wavelength fs lasers. Among the 275 articles published in the 5 years period, 186 (68%) are in international journals with co-authors in the USA, Austria, Russian Federation, Germany, Belarus, France, UK, Italy and Belgium. These publications are done in good or very good journals (Nanoletters 2014, 14, 1508, Carbon 2013, 52, 574), some of them are invited (Applied Physics A 2014, 114, 231, Journal of Phys. D: Applied Physics 2010, 43, 273001, Applied Physics A 2014, 114, 231, J. Infrared Milli THz Waves, 2009, 30, 2009) or have made the cover of APL (2014). In 2014, two developments of the Unit were underlined by the technical magazines "Compounds Semiconductors" and "EE Times Europe". The quality of the science produced in the Unit is recognized by the scientific community through the invited papers at International Conferences (A. Krotkus, G. Račiukaitis or G. Valusis) and by the fact that it is the coordinator of a very large European FP7 Project "APOLLO".

It is clear that the Unit is on a very positive slope. Among the 20 important papers of the Unit, 11 have been published in 2014 and some are of very high quality (as indicated above). All these facts explain the grade 4 given by the Panel for the quality of the research.

The economic and social impact of the research in Lithuania

Due to the links with EKSPLA, the collaboration with industry is in the 'genes' of the laboratory. The Laser Technologies Department is performing up to 10 industrial research projects/year: from one month to two years long. Income from such projects has reached 25% of the budget.

It is also strongly involved (it is the coordinator) in the FP7 APPOLO project with 21 other partners from Europe and Israel and 15 SMEs and large industrial companies. It seeks to establish and coordinate connections between the end-users, which have demand on laser technologies for (micro) fabrication, knowledge accumulated in the application laboratories of the research institutes and universities and the laser equipment manufacturers (preferably SMEs) for novel lasers, beam control and guiding, etc. and their integration in order to facilitate faster validation of the process feasibility and adaptation of the equipment for manufacturing condition. The project started in September 2013 and will finish in August 2017: the EC contribution is 11 M€.

The Optoelectronics department has, between 2011 and 2014, obtained 7 contracts for EUREKA, EUROSTARS projects.

Three spin-off companies have been created: UAB ELAS (Laser Technologies Department with companies EKSPLA and ALTECHNA), UAB TERAVIL and in 2013 LUVITERA (Optoelectronics Department).

One should also notice the creation of BALTFAB, a joint Open User Facility with the Nanoengineering Department at the Center for Physical Sciences and Technology, offering a full range of nano/micro and macro fabrication as well as laser patterning, marking and cutting on any required material.

This Unit is an excellent example of high level basic and applied research and transfer to industry. The scientists participate actively in the popularization of their achievements in printed media, TV and on internet to increase the visibility of their achievements. There is also a strong participation in events like the "Science Night" and the "Photonics Day".

The physical infrastructure of the UoA

The Unit has quite a modern infrastructure, technological and experimental equipment thanks to various European grants: molecular beam epitaxy reactor, 2 fs laser, fs laser with OPA, rapid thermal annealing oven, THz laser FIRL-100, open access BALTFAB, probe-precision measurement system, compact 0.1-0.6 THz imaging system, IR spectrometer, FTIR spectrometer with vacuum option, vacuum deposition system, 4K closed cycle refrigerator system.

The Department of Laser Technologies uses modern technologies for optical coatings (e-beam, ion-beam deposition, magnetron sputtering…). The Optoelectronics Department has probably the best MBE system in the Baltic countries but it needs some equipment for the development of semiconductor devices all the way to the prototype stage allowing transfer to the industry.

A good fraction of the equipment is available to external users. We have been astonished by the low number of administrative personnel (3): knowing the heaviness of the European contracts, this is small number. The Unit has also few technicians and engineers: modern equipment as MBE, e-beam, ion-beam deposition needs continuous maintenance and development. This should be done by qualified engineers, not students or postdocs because in that case there is no continuity when they leave. In the same way, one should have electronic and mechanical engineers to develop prototypes to be transferred to industrial companies.

Most of the laser laboratories are now located in the Campus of the former Institute of Physics where CPST has the Science and Technology park and a cluster of laser and engineering companies LITEK which is finishing the construction of new laboratories for industrial companies. Next year, the CPST will be moving in new facilities at the Saulėtekis Valley.

Research management (including career development and human resource management) of the UoA

THE CPST has implemented the ISO 9001:2008, quality management system. The age pyramid is very good. The Unit seems to make a large effort for the young generation. In addition to the Bachelor and Master students, there are today about 30 PhD or Master students of Vilnius University, Kaunas Technical University conducting their research for their thesis. During the meeting that we had with them, we were impressed by their enthusiasm. They work part-time as technicians or engineers. In this way the students have the possibility to work on complex scientific equipment, do research and present their results at seminars and conferences. The best students can continue as PhD students. Those ones are encouraged to regularly present their research results, new ideas of research or results published in good journals at seminars taking place in the Unit (daily basis). All of them participate, at least once, at Schools/Conferences for young researchers taking place in Palanga (Lithuania) and in Jaszowiec (Poland). The best ones are encouraged to spend a year or more as postdocs abroad. Actually, postdocs are working at Rochester University (USA) and Sheffield University (UK). This system seems to be well adapted to the specific situation of Lithuania.

The development potential of the UoA

The Unit has shown its capacity to raise funds from the international programmes, industry and from other sources of funding. It has now a very modern infrastructure. The fields of research developed in the 2 departments are very important for Lithuania. The Unit is on a very positive slope and has the capacity to increase its impact. The Department of Laser Technologies not only produces high quality science but its interaction with industry is remarkable. The Optoelectronics Department is a leader in the field of surface THz emitters and optoelectronic components for THz-time domain spectroscopy. This is due to a strong collaboration between technologists, physicists investigating semiconducting materials properties, and engineers creating semiconductors devices and systems based on them: even at the international level this is not so common. The future vision and plans are very clear.

The management had made a good analysis of the strengths and opportunities (already underlined), the weaknesses (shortage of technological equipment for the development of semiconductor devices all the way to the prototype stage, absence of mechanical and electronic engineers useful to develop devices until the final stage) and threats (weak legal support for defending intellectual properties right of researchers, narrow high-tech sector in the country and low interest for innovations in the remaining national industries).

The age pyramid is excellent and the capacity to attract a large number of students is evident but the Unit should exploit the possibility to have foreign postdocs with European grants. The Unit has a critical mass but should be slightly increased if one likes to develop devices until the final stage.

Conclusions and recommendations

The success of these 2 Departments is due to the fact that the Management has very focused goals:

- Development of material growth technologies for infrared and THz frequency range optoelectronics devices
- Laser diodes and light emitting diodes with tailored mid-IR wavelengths range with active layers of dilute bismide or antimonide compounds
- THz radiation emitters, mixers, detectors activated by lasers emitting in the telecom wavelength range of 1. 5 μm
- Development of new concepts for THz range imaging
- Technologies for optical coatings
- Ultra short pulse fiber oscillators and amplifiers
- New concepts and architectures of solid state lasers
- Applications of lasers for microprocessing

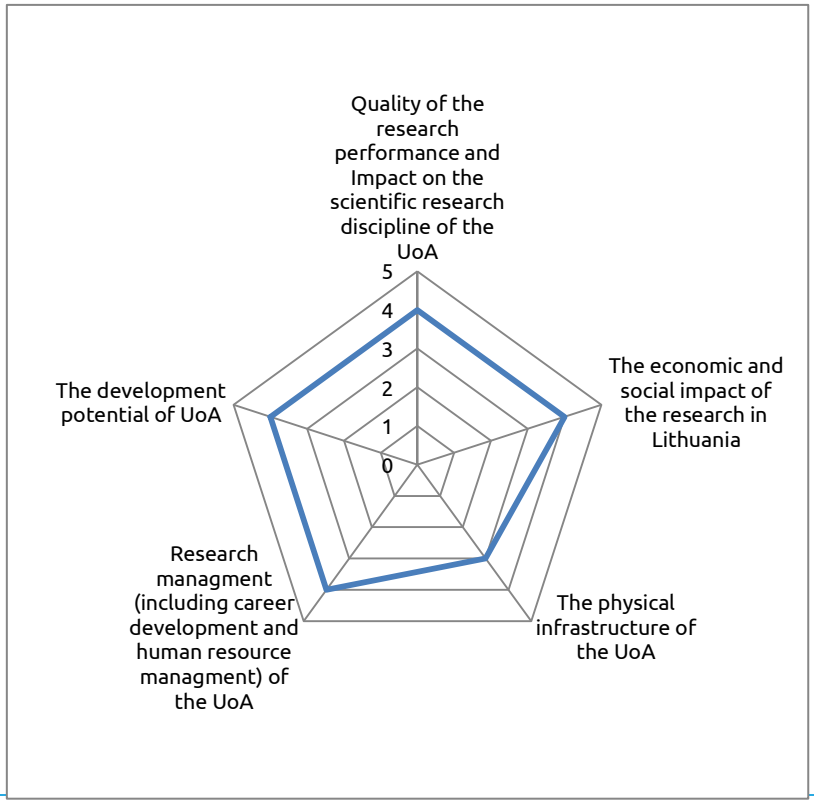
They should continue like that. This is very different from many Units visited, which are trying to tackle too many fields with a limited number of people and small funding.

- The Panel recommends:
- An increase of the state funding which is too low to hire permanent engineers allowing to move from basic science to industrial applications. Lithuania has the chance to have a Unit of this quality: they should have better treatment.
- Sophisticated modern equipment needs continuous maintenance and development: if this is done by students, you have problems when they leave.
- A small effort to publish in high profile journals (like for example Nano letters): the results obtained allow that.

Faculty of Physics, Vilnius University

Name of the UoA	Faculty of Physics
Name of institution being assessed	Vilnius University
Total no. FTE researchers	92,42
Composition of the Unit of Assessment (UoA)	Faculty of Physics: Department of General Physics and Spectroscopy; Department of Solid State Electronics; Department of Radiophysics; Department of Quantum Electronics; Department of Semiconductor Physics; Department of Theoretical Physics; Astronomical Observatory

Quality of the research performance and Impact on the scientific research discipline of the UoA	4
The economic and social impact of the research in Lithuania	4
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	4
OVERALL SCORE	4



OVERALL SCORE

This Unit is one of the largest in Lithuania in its field, having 6 departments and an observatory, with the number of FTE's being 92. The three main research fields include solid state physics and technology, spectrometric characterization of materials and electronic/molecular processes as well as laser physics and technology. It has a solid publication record with several papers in the top international journals, with more than half of those being published in collaboration with groups outside Lithuania. In other words, the international collaboration is at a good level. Many of the researchers have visited for extensive periods outside Lithuania.

The Unit has good collaboration with the VU Institute of Applied Research as well as with FTMC Optoelectronics and Laser Technologies Unit, supporting actively the development of high-tech laser-based products in Lithuania. The Unit has experimental and computational equipment of good international quality. The laser research facility equipment is excellent. The Unit attracts high quality physics students in Lithuania, and young students are involved with the research leading to journal papers already during their Batchelor's studies. The research is carried in well-structured research groups, including a senior PI, post-docs as well as PhD students, with both Masters and even Batchelor's students joining the groups.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The scientific production is good at the international level. Over 885 articles have been published during the period of evaluation, and 541 (61 %) have international co-authors from USA, Germany, France, UK, Ukraine, Sweden, Russian Federation, Belarus and Italy. Among the 20 selected papers shown in the report, all of them are published in good quality international journals, some being really excellent. 20 presentations were given at the international scientific meetings.

The economic and social impact of the research in Lithuania

Two spin-off companies have been created and 3 patents granted. The Unit has received a large number (over 50) of contracts for market oriented research. Eleven international projects have been joined. In addition, the Unit has collaborated with high-tech international companies in USA and in the Russian Federation. Also, the Unit has actively worked in the journal editorial boards both internationally and nationally, and supported government and private companies as experts and as board members.

The physical infrastructure of the UoA

Overall the Unit has experimental and computational equipment of reasonably good international quality. Especially, the laser research facility equipment is excellent, being absolutely competitive in the international level. The unit collaborates with FTMC Optoelectronics and Laser Technologies Unit regarding the infrastructure as well as research in the field of laser optics and applications. It is utilizing the Open Access Center for Physical Sciences and Technologies (OAC), which is based on the National Center for Physical Science and Technologies (NFTMC). It offers research in materials science, quantum physics and chemistry from technological approach to process simulations with supercomputer, high quality infrastructures as well as open access labs. These include clean room facilities, device manufacturing and characterization equipment. To summarize, the research infrastructure in the field of lasers is really at high international level, and at the good international level in the other research areas.

Research management (including career development and human resource management) of the UoA

The research is carried in well-structured research groups, including a senior PI, post-docs as well as PhD students, with both Masters and even Batchelor's students joining the groups. This structure seems to originate from the fact that many of the researchers have spent extensive periods outside Lithuania during their career. The Unit actively supports Batchelor and Master Students to join the research groups during their studies, thus leading to high number of motivated PhD students in the Unit. Every year about 10 students are sent outside Lithuania for international research experience. The research is organized effectively and the atmosphere in the visited laboratories was really encouraging and open for discussions of new ideas and collaborations. Each group had well defined goals in their research. It was the norm that PhD students, post-docs as well as faculty would spend time outside Lithuania, accordingly international collaboration was part of the everyday operation. The difficulty of buying equipment was mentioned during the visits, based on the too much rules at the national level. The teaching load for the full time professors was considered to be too high, reducing the professor's participation to the research.

The development potential of UoA

The Unit has the really high potential to participate in the international arena, especially in the field of developeing and applying laser technologies. In the last few year a significant amount i.e. about 14 M€ has been invested into a new research infrastructure. There is a good balance between the number of FTEs and the number of both administrative and technical personnel. Due to modern research organization with PI leading the group consistong of post-doc, PhD- as well younger students, the unit is able to participate in

international competition. The selecetd research topics and achieved results already impact the international scientific community as well as the national society. Due to good infrastructure and active researchers, the unit can initiate new research directions, especially in the laser research field. The unit is large enough to have the critical mass. The highest level physics students enter the Unit, which allows unit to involve young active scientists needed in the international competition. It has been able to raise succesfully national competitive funding, e.g. during 2014 more than 50 % of the funding originated from this source. It has been involved in the very large number of international collaborative projects. However, the unit should aim to increase the share of international funding.

Conclusions and recommendations

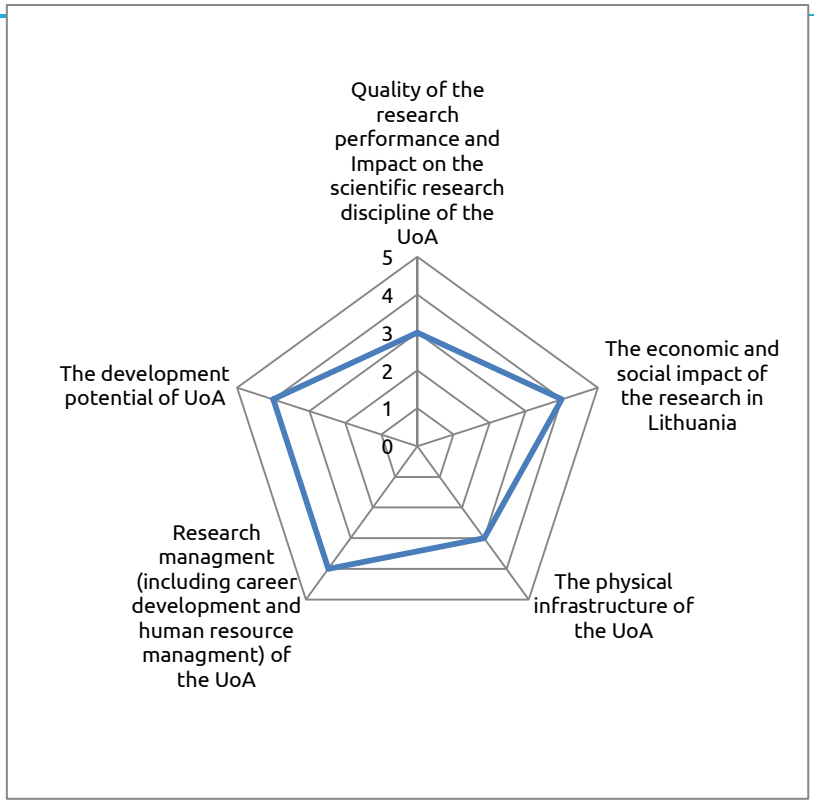
The Unit has a solid publication record with several papers in the top international journals, with more than half of those being published in collaboration with groups outside Lithuania. The international collaboration is at the good level. Many of the researchers have spent extensive periods outside Lithuania. The Unit has good collaboration with the VU Institute of Applied Research as well as with FTMC Optoelectronics and Laser Technologies Unit, supporting actively the development of high-tech laser-based products in Lithuania. The Unit has experimental and computational equipment of good international quality. The laser research facility equipment is excellent.

In order to fully utilize the large investments on research infrastructure, the Panel recommends a reduction in the number of low impact factor papers, to join actively international research programs via e.g. H2020 projects and accordingly increase the size of the research projects.

Institute of Applied Research, Vilnius University

Name of the UoA	Institute of Applied Research
Name of institution being assessed	Vilnius University
Total no. FTE researchers	36,75
Composition of the Unit of Assessment (UoA)	Division of New Materials Research and Technology; Division of Advanced Technologies; Division of Semiconductor Optoelectronics

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	4
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	4
OVERALL SCORE	4



OVERALL SCORE

This Unit has 3 divisions with the number of FTE's being 37. The main research fields include electrical and optical characterisation of defects in semiconducting materials and in devices like solar cells, power transducers and radiation detectors, development of GaN and alloys by MOCVD for solar cells, LEDs and TFT-FETs and also the development of organic electronics materials. The main mission is to carry out applied research with industry.

It has a reasonably good publication record with several papers in good level international journals, with more than half of those being published in collaboration with groups outside Lithuania. In other words, the international collaboration is at the good level. The Unit has very close collaboration with the VU Faculty of Physics. Also, it collaborates with FTMC Optoelectronics and Laser Technologies Unit, being the co-founder of the Open Access Center for Physical Sciences and Technologies (OAC) operating the FTMC Unit.

The Unit has experimental and computational equipment of good international quality. The Unit attracts physics students from VU Faculty of Physics, these students work within the Unit and graduate at the University Faculty. The research is carried in the well-structured research groups, including a senior PI, post-docs as well as PhD students, with both MS and even BS students joining the groups.

Quality of the research performance and Impact on the scientific research discipline of the UoA

It has a reasonably good publication record with 326 articles produced and having several papers in good level international journals, with more than half of those being published in collaboration with groups outside Lithuania. The Unit has collaborations with foreign university laboratories in 12 countries and with institutes in 3 countries. Accordingly, the international collaboration is at the good level. The scientists have memberships in the international journal editorial boards.

The economic and social impact of the research in Lithuania

A spin-off company (Ledigma Ltd) was established in 2012 to commercialize research results in the field of solid state lightning. The Unit has 3 patents and it collaborates with the leading international companies in its field. It also actively participates in the national committees. It has a reasonably good level of funding from EU programs.

The physical infrastructure of the UoA

The Unit has experimental and computational equipment of good international quality. It collaborates with FTMC Optoelectronics and Laser Technologies Unit regarding the infrastructure. It is the co-founder of the Open Access Center for Physical Sciences and Technologies (OAC), which is based on the National Center for Physical Science and Technologies (NFTMC). It offers research in materials science, quantum physics and chemistry from technological approach to process simulations with supercomputer, high quality infrastructures as well as open access labs. These include clean room facilities, device manufacturing and characterization equipment.

Research management (including career development and human resource management) of the UoA

The Unit has a clear main mission, i.e. to carry out applied research with industry within its research fields. The Unit attracts physics students from VU Faculty of Physics, these students work within the Unit and graduate at the University Faculty. The research is well organized in the modern manner, i.e. it is carried in the well-structured research groups, including a senior PI, post-docs as well as PhD students, with both Master and even Batchelor students joining the groups. The human resource development strategy was also nicely developed. The 10 best scientists are nominated every year, and the authors receive a bonus for publishing a reviewed paper the scientific journals, this bonus being significant for a high impact factor paper. The long-term strategic and financial resource planning was clearly visible during the site visit, the mission being to carry out applied research in collaboration with industry in the fields of applied physics, electrical engineering and optics, more specifically focusing on LED, OLED as well as semiconductor materials for these applications. To summarize, the human research management and allocation were well planned and taken care. The students were involved in the research from the undergraduate level, due to close collaboration with the VU Physics Department at the same building.

The development potential of UoA

Due to the new research infrastructure as well as well the defined research mission and smooth collaboration with VU Faculty of Physics and FTMC Optoelectronics and Laser Technologies, the Unit has potential to participate in the international competition and even impact the international scientific community. This however requires more effort to publish higher impact factor papers. Also, more activity would be required to win larger international projects from e.g. EU. The scientific environment as well as the equipment supports the chosen research directions well. Due to the applied nature of the research, the activity to patent and establish new companies could be increased. The unit has clear vision as well as realistic mission for its research activities. The age and career progression of the active scientific staff is well taken care. The Unit

can reach the critical mass needed for the real international impact with further focusing of its research areas. It has ability to attract high-level doctoral students and scientists from Lithuania, but it should aim to attract high level scientists from outside Lithuania. It clearly has the ability to raise funding that is awarded competitively at the national level, and should aim to increase the level of international funding, which during 2011-13 was about 12 % of the total budget. E.g. it is a partner in the EU FP7 project NEWLED with the EU income of 335 400 € during 2012-16.

Conclusions and recommendations

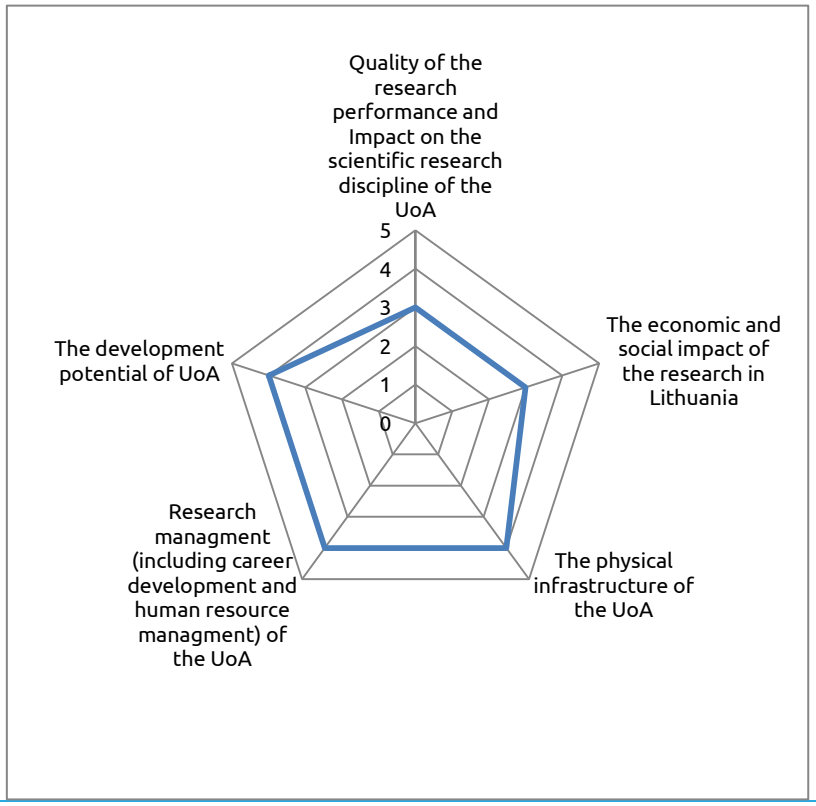
It has a reasonably good publication record with several papers in the good level international journals, with more than half of those being published in collaboration with groups outside Lithuania. In other words, the international collaboration is at the good level.

The Unit has very close collaboration with the VU Faculty of Physics. Also, it collaborates with FTMC Optoelectronics and Laser Technologies Unit, being the co-founder of the Open Access Center for Physical Sciences and Technologies (OAC) operating the FTMC Unit. The Unit has experimental and computational equipment of good international quality. The Unit attracts physics students from VU Faculty of Physics, these students work within the Unit and graduate at the University Faculty. The research is carried out in the well-structured research groups, including a senior PI, post-docs as well as PhD students, with both Masters and even Batchelor students joining the groups. To compete at the truly internationally high level, more efforts are needed to publish in higher impact factor journals. Also more activity would be required to win larger and longer term international projects from e.g. H2020. Due to applied nature of the research, the activity to patent and establish new companies could be increased.

Natural Sciences and Materials Science, Kaunas University of Technology

Name of the UoA	Natural Sciences and Materials Science
Name of institution being assessed	Kaunas University of Technology
Total no. FTE researchers	32,99
Composition of the Unit of Assessment (UoA)	Faculty of Mathematics and Natural Sciences; Departments: Applied Mathematics; Mathematical Modelling; Physics; Centres: Nonlinear System Research Centre; Research Centre for Microsystems and Nanotechnology; Centre of Laboratories; Student Representative Board; Institute of Materials Science:Research Laboratory of Surfaces and Thin Films; Nano- and Microlithography Research Laboratory; Research Laboratory of Vacuum and Plasma Processes; Research Laboratory of Development and Implementation

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	4
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	4
OVERALL SCORE	4



OVERALL SCORE

There are mark “3” given in research quality and economic and social impact, while infrastructure, research management and overall potential have mark “4”. The Unit shows high to very high development potential both in Lithuania and internationally, supported by researchers age distribution, enthusiastic PhDs, good support from the University and modern laboratories and other facilities. The work of the Unit is well visible inside Lithuania, but needs close integration with industry.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit consists of the Faculty of Mathematics and Natural Sciences including 3 departments (Applied Mathematics, Mathematical Modelling, Physics), 3 Centres (Nonlinear System Research Centre, Research Centre for Microsystems and Nanotechnology, Centre of Laboratories) and the Institute of Material Sciences, including the Research Laboratory of Surfaces and Thin Films, Nano- and Microlithography

Research Laboratory, Research Laboratory of Vacuum and Plasma Processes, Research Laboratory of Development and Implementation.

There are 8 research fields ranging from mathematics and physics (as the major fields), material engineering, biochemistry to education. This large study spectrum is covered by about 11 professors, ca 30 associated professors and a number of lecturers and assistants. However, the research staff includes only 0,33 chief researchers, 0,25 senior researchers and 1 researcher (as staff in FTE in 2013), which is small number for such a large research area. The number of publications in peer reviewed journal ranges 44 to 59 per year during 2009-2013, having 8.8 papers per researcher. 55 articles have been published in cooperation with international co-authors, which is a quite low percentage from the overall publications (19%). During that period also one patent has been granted, in addition to a number of prototypes. During 2011-2013 the overall funding had increased from 484 000 to 1 10 ,000 Euros, while national R&D competitive funding has the most prominent increase (from 183 000 to 887 000 Euros).

The economic and social impact of the research in Lithuania

A number of staff members are represented in editorial boards of journals, in different committees and other state bodies. The Faculty sub-Unit has not recently produced any spin-off companies, there is a student acting as CEO in a mobile solution start-up company. The sub-Unit research in the field of optical document security has led to establishment of a Spin-off company. Other public impacts include applied research projects and organising conferences. For example, the Department of Physics has also a museum with various exhibitions.

There is a number of market-oriented research projects, for example in holographic security systems (2008-2010, ca 250 000 Euros), micromechanical systems (2007-2009, ca 190 000 Euros), nanostructure formations. There is also a EUREKA/EUROSTARS project (2009-2012, ca 40 000 Euros), an EU framework 7 project NANOMAT (2009-2012, ca 796 000 Euros), and an EU Framework 7 project NANOSUSTAIN (2010-2013, ca 77 000 Euros). Most of contract research is, however, short term projects with the grants not exceeding usually 5 000 to 10 000 Euros per contract. The work of the Unit is visible inside Lithuania. However, based on decreasing funding from the industry - from 15 000 Euros in 2011 to 0 in 2013 (according to the SAR at March 2014), there is a sign that the Unit's research has not sufficiently taken up by national or international companies.

The physical infrastructure of the UoA

The Unit's infrastructure is modern and well suitable for most of the research projects. The Laboratory Center provides services for external users, for example, altogether 11 000 hours are planned for external use in 2015 (Open Access Center). The list of equipment includes SEMs, e-beam lithography, nanoimprint module, mask aligners, vacuum evaporation units, ion etching systems, microwave plasma enhanced chemical vapour deposition systems, dot-matrix hologram system, X-ray photoelectron spectroscope, ARXPS, atomic force microscope, XRF, Raman scattering spectrometer, Fourier transform spectrometer, UV-VIS spectrometer and a number of other instruments and measuring facilities. The Unit has access to appropriate databases and library facilities. Most of equipment is accessible for external users.

Research management (including career development and human resource management) of the UoA

The age pyramid of the Unit is good: more than 50 staff members are below 34 (28 below 25), 31 between 35-44 and 13 researchers between 45-54. The number of Master degrees awarded in 2013 was 34, which is lower than in 2011 and 2012.

Four doctoral degrees were awarded in 2013. However, the number of enrolled doctoral students ranges between 4 to 6, which is low considering such a large study spectrum of the Unit. There have been 1-3 Postdoctoral members, including one foreign Postdoctoral researcher; only one Postdoctoral researcher was

listed in 2013. Most of doctoral students are involved as lecturers, assistants and junior researchers. In this way the students have the possibility to work on complex scientific equipment, do research and present their results at seminars and conferences.

All PhD students get excellent supervision. During the meeting that we had with them, we were impressed by their enthusiasm. The University provides excellent support for PhD students and researchers. The PhD students are now expected to take at least one Course/Module abroad during their studies. There is also a support mechanism for teaching and research staff sabbaticals. Young PhDs are encouraged to take Postdoctoral positions abroad. As in many other Units in Lithuania, the number of people in the administration and the technical support is probably too small in comparison with the number of teaching and research staff.

The development potential of UoA

It is important to incorporate more PhD students and Postdoctoral researchers from national universities and universities abroad. The Unit has shown its capacity to raise funds (from ca 500 000 kEuros in 2011 to ca 1 100 000 Euros in 2013), especially from competitive funding. However, based on decreasing funding from the industry - from 15 000 Euros in 2011 to 0 in 2013, there is a sign that the Unit's research has not sufficiently taken up by national or international companies, this question should be addressed seriously.

The Unit has a modern infrastructure and a good age group distribution, the critical mass, which altogether support chosen research directions nationally and internationally. The Unit has a very good development potential at national and international level if proper career mechanisms (increase a number of PhDs and possibly PostDocs) are progressively applied, more industry oriented projects started, and wider international research visibility achieved. Better focussing on the “best research” of the Unit will enhance both; better basic and applied research results and better and wider international recognition.

Conclusions and recommendations

The Unit has good potential in Lithuania and internationally, supported by researchers age distribution, enthusiastic PhDs, good support from the University and modern equipment and facilities.

The Panel recommends:

The better focussing of the Unit’s best research in order to promote better basic and applied research results and more visible and wider international recognition.

There is need to increase the number of PhD students and Postdoctoral researchers.

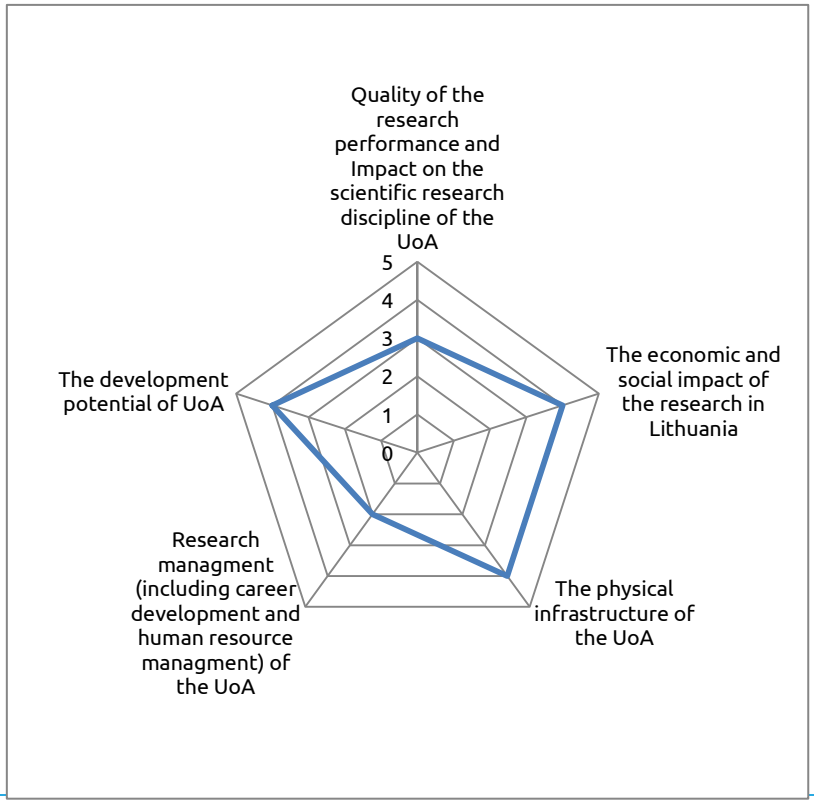
The wider use of English at labs and in PhD defence (thesis) in order to give better opportunities for international cooperation and integration.

The Unit's research has not been taken up by national or international companies, so there is need for better marketing of the Unit’s facilities and competence nationally and internationally.

Institute of Biotechnology, Vilnius University

Name of the UoA	Institute of Biotechnology
Name of institution being assessed	Vilnius University
Total no. FTE researchers	101,61
Composition of the Unit of Assessment (UoA)	Department of Protein-Nucleic Acids Interaction; Department of Biological DNA Modification; Department of Eukaryote Genetic Engineering; Department of Immunology and Cell Biology; Department of Biothermodynamics and Drug Design; Department of Bioinformatics; Sector of Applied Biocatalysis; Sector of Microtechnologies

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	4
The physical infrastructure of the UoA	4
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	4
OVERALL SCORE	4



OVERALL SCORE

The Unit has a distinguished history as Lithuania's leading biotechnology centre. It is a large UoA with 6 departments and 8 sectors and employs over 200 people. Research areas are in subjects of contemporary relevance with a good mix of different topics and allied analytical techniques. Now part of Vilnius University it has maintained close contacts with industry and continues to deliver research in both basic and applied areas. Its position in the national research landscape is secure and can be further developed, although the ambition in the Unit for future developments is low.

Quality of the research performance and Impact on the scientific research discipline of the UoA

One of the largest of the Units evaluated in terms of FTE and overall level of government funding. Quantitative output is good in absolute terms. The output per researcher and in relation to funding received falls short of expectations for a Unit with good international standing and integration. Individual contributions are very good with some very high impact publications. Clearly, individual research groups operate at an internationally competitive level. The number of postgraduate students is too low for the Unit's size. Good level of international mobility. The level of qualification is evident from significant involvement

in FP funding and participation in international events. The Unit attracts the top Ph.D. students in the country.

The economic and social impact of the research in Lithuania

The Unit has a strong record of delivering applied research of industrial relevance and in technology transfer. A significant number of patents and start-up companies are reported with overall a significant industrial outgrowth from the UoA. The Unit is relevant for the local economic infrastructure as indicated by the number and value of contract research projects. In terms of applied research delivery, a clear strategy and appropriate research topics have benefitted the Unit. The Unit delivers value for money in terms of applied research impact on the economy, less so on society. However, this has come at the expense of basic research impact delivery. There is evidence for linking the Unit to SME's and relevant policy institutions. Noteworthy is an active and well received school outreach program.

Experience in technology transfer is the main strength of this Unit and in this context it surpasses the other UoA. Yet, this is not capitalized on in terms of education (specific training of postgraduate students), international visibility (marketing), further funding (*e.g.*, as leader in major EU grant initiatives) and HR development (motivation of personnel).

The physical infrastructure of the UoA

The Unit is well equipped with all required instrumentation, offers shared services, and provides service facilities for other users. Most of the advanced instrumentation has been purchased in recent years and all, *e.g.*, the automatic crystallization and diffraction equipment, are state-of-the-art. The Unit shares the building with former start-up companies (e.g., Thermo-Fisher) and other SME's giving synergy potential. Integration into a future Life Sciences Center might impact on this. While not needed at present, a Level 3 biological containment laboratory in the country would be best be situated in this Unit.

Research management (including career development and human resource management) of the UoA

The Unit's reports active management systems (performance based salary modifications, attraction of best Ph.D. students, etc.) in place. Future plans are mentioned with sketchy details. Despite a large cohort of postgraduate students and the high calibre thereof, there is no postgraduate training program. Integration of the Unit in Vilnius University exists on paper only; the UoA sees itself apart from the mother institution and considers the latter a threat. HR management is not acceptable. Neither the Ph.D. students nor the researchers had any idea about the assessment visit and were not prepared. All personnel lack vision and ambition. While working on a day-to-day basis in terms of supervision, a more focussed and strategic approach to HR management will significantly increase the Unit's performance. Positive aspects are the presence of an International Advisory Board and the possibility for young researchers to establish their own, independent laboratory without administrative hurdles.

The development potential of the UoA

The potential of the Unit is significant. All the basics are there: good age structure, excellent Ph.D. students, superior industry-related output, good visibility in the Lithuanian research landscape, and several highly competitive individual research groups. Its strong position in the local biotechnology sector offers the potential to be a leading institution. Nevertheless, the low relative research output (per researcher and in relation to funding) must be addressed and with the present management structure and policies its future is limited.

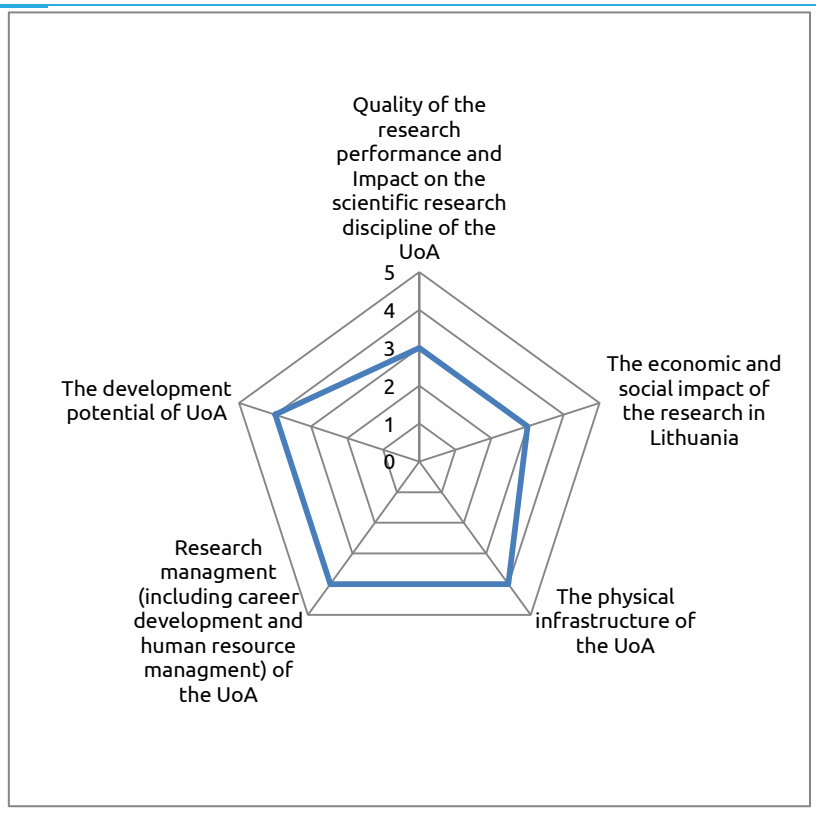
Conclusions and recommendations

The UoA delivers significant economic impact and is a leader in the biological sciences in Lithuania. Excellent infrastructure, industry relations and some internationally recognized researchers form a secure national basis for the future. The disconnect between potential and impact delivery and the lack of motivation in the Unit must be addressed as a matter of urgency.

Sustainable Chemistry, Kaunas University of Technology

Name of the UoA	Sustainable Chemistry
Name of institution being assessed	Kaunas University of Technology
Total no. FTE researchers	40,4
Composition of the Unit of Assessment (UoA)	Synthetic Chemistry Institute; Department of Environmental Technologies; Department of Organic Chemistry; Department of Physical and Inorganic Chemistry

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	4
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	4
OVERALL SCORE	3



OVERALL SCORE

The overall score is 3 but not far from 4. The grade is based on the good quality of the scientific production

(but we would like to see an increase of publications in international journals), to a good economic and social impact, to the excellent physical infrastructure with very modern equipment and the remarkable research management, especially in the capacity to attract a very large number of master and PhD students which is fundamental for the future of the Unit. We have also been impressed by the strong support of the University.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit is made up of 4 Departments:

- Synthetic Chemistry Institute
- Environmental Technologies
- Organic Chemistry
- Physical and Inorganic Chemistry

The main fields of research include organic chemistry (with emphasis on synthetic chemistry), inorganic and physical chemistry, environmental chemistry and technology, and bio-technology (with emphasis on plant

biotechnology). The Unit has 12.8 academic FTEs and 27.6 researchers. There is no administrative personnel and 7.25 Technical. The total number of PhD graduates during the 5 year period has been 27 and the Unit has today 28 PhD students and 27 Master students: this is remarkable. The Unit has collaborations with very good laboratories of 13 foreign Universities or Research Institutes. It has produced 194 articles in refereed journals but only 78 (40%) with international co-authors (from Austria, Ukraine, France, UK, Sweden, the Netherlands, Spain, Japan and Taiwan). The publications in English are of good quality, in journals with impactor varying between 2.2 and 6. 7 but they are only 10 presented in the report. The Unit is trying to increase its funding rather successfully but it is still low. For an annual average R&D budget of 875 k€, 163 k€ come from international programmes and 133 k€ from industry: this is good.

In conclusion, the Unit is a strong national player with a good international recognition. It needs to increase the scientific production in international journals, especially the Inorganic Chemistry.

The economic and social impact of the research in Lithuania

The Unit has many contracts with national companies but for small amount: 3 to 5 k€ but they do better with foreign industry.

- Research agreement with Basf (Germany) on solid phase organic semiconductors for photovoltaics cells (2012).
- Research agreement with REC (Hungary) on Schools Indoor Pollution and Health: Observatory Network in Europe (2010-2012).
- Participation in themed network Wetsus
- Joint research with UAB Kaunovandenys
- Joint research with Kauno svara
- Confidential contract (204/2011) of 613 k€ and another of 297 k€ (2006/2014)

Up to date the Unit has not created spin-off companies but has produced 3 patents on organic photoreceptors. The reason is that the Unit historically relied on grant-based funding papers as the most important outcomes. Now, the Unit is focusing more on applied research to solve specific problems raised by industries or funding agencies. New compounds are being developed with the clear goal of application to the pharmaceutical, construction, energy storage and production applications. Several years ago, the National Centre of Business and Innovation has been established to facilitate communication with industry and establishment of spin-off companies.

The physical infrastructure of the UoA

The Unit has expanded in a new building of the Santaka Valley project: built with EU funds, it is a national open access research and experimental development R&D centre of international standard, concentrating in one territory science and studies potential of the following most promising areas: sustainable chemistry and bio pharmacy, future energy, mechatronics, information and communication technologies). Very modern equipment for the characterization of most properties of chemical substances has been installed. It provides all the necessary communications for the chemical laboratories but most of the Unit's researchers are still located in the old heritage buildings which have a lack of basic infrastructure. Today, there is up-to-date equipment for the characterization of most properties of chemical substances. Among these, one can cite the 400 and 700 (the only one in Lithuania) MHz Bruker NMR, a Bruker X-Ray diffractometer, a nanosecond flash photolysis measurement system. Further funding is expected via the RI Applied chemistry and bio pharmacy for the period 2014-2020 The Unit has sufficient computer resources, access to libraries and major databases. The report points out the serious problem of recruiting good technical personnel due to a monthly salary of 400€. The Unit has no administrative personnel and 7.5 FTEs in the technical staff.

Research management (including career development and human resource management) of the UoA.

The Research Management is in a phase of improvement and is more centralized (before 2011 it was done in each Department). It is expected, that the newly establishment management system of open access centre will assure optimal operation of the research infrastructure and increase the productivity of the Unit.

Within the Unit, the research is managed via departments and institute administration; yearly plans for research production are set and the groups are aware of the amount of production they have to achieve. Special attention is paid to grant-based research and the Unit is doing well in that area. These projects rely on the involvements of young researchers: this is done through Bachelor studies, extending this to Master studies and making it easier for students to enter PhD studies. After obtaining their PhD, many of the graduates stay in the research groups. We already pointed out the enormous investment of the Management for the future: 28 PhD students and 27 Master students!

Through the University, there are possibilities to participate in Erasmus exchange programs, funding opportunities to conference and research visits, yearly competitions for the best younger researchers and various prizes. For most of the researchers, the main activity is teaching but there are some differences between Departments: the Organic Chemistry is doing more research and has higher scientific production, while Inorganic Chemistry mostly deals with teaching and has lower scientific output. We have to underline that the age pyramid of the Unit is excellent.

The strategic plan is to continuously increase the scientific production to be competitive at the world wide level, to strengthen cooperation with industries as well as building the capacities to increase the formation of research-based start-up and spin-off companies: the new infrastructures, the very modern equipment and the remarkable politics for increasing the number of Master and PhD students should allow that.

The development potential of the UoA

Due to the implementation of the Santaka Valley, it is clear that the Unit has a large potential, especially by integrating more biological sciences. The Unit is leading the RI Applied Chemistry and Bio pharmacy: within this cluster. The following facilities will be implemented : Centre for Biopolymers and Biomedical Materials, Centre for Industrial Chemistry and Biotechnology, Centre for Applied Electrochemistry, Laboratory of Medical Chemistry, Laboratory of Aerosol Science and Technology. The existing facilities will also be improved by adding some necessary infrastructure but part of the Unit is in heritage buildings, which complicates and increases price of renovation works.

The Unit has analysed carefully the strengths, opportunities, weaknesses and threats: there are three problems:

- Most of the researchers have a heavy load of teaching, especially in the Inorganic Chemistry Department, penalising the research
- Insufficient funding. It is nice to have new buildings and very modern equipment but this means large maintenance budgets, especially for NMR machines
- The Unit misses input from local industry for the formation of the research ecosystem

The age pyramid of the unit is excellent. The management should be congratulated for its capacity to attract 27 Master and 28 PhD students. The unit should make an effort to attract foreign postdocs: Brussels has special grants for that and nobody seems to know that in Lithuania.

Conclusions and recommendations

This Unit is a Strong National Player with some international recognition but with a small effort it could move to a grade of 4.

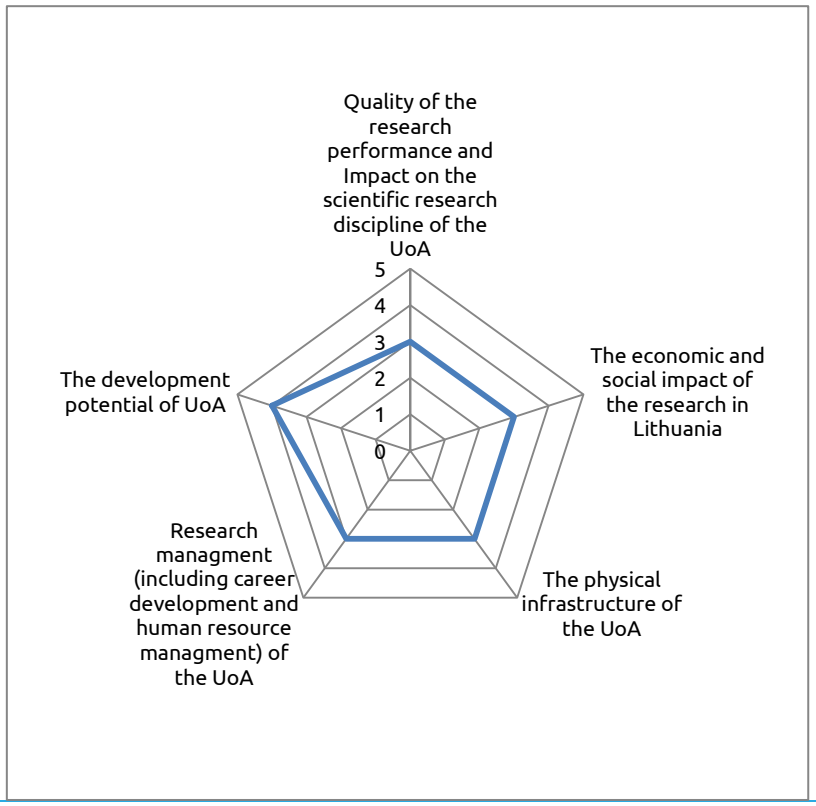
The Unit has to increase its scientific production and the number of publications in international journals, especially in the field of inorganic chemistry.

The Unit needs to increase its funding and make efforts in the direction of the industry.

Environmental and chemical physics, Center for Physical Sciences and Technology

Name of the UoA	Environmental and chemical physics
Name of institution being assessed	Center for Physical Sciences and Technology
Total no. FTE researchers	76
Composition of the Unit of Assessment (UoA)	ENVIRONMENTAL RESEARCH DEPARTMENT; NUCLEAR RESEARCH DEPARTMENT; MOLECULAR COMPOUNDS PHYSICS DEPARTMENT; NANOENGINEERING DEPARTMENT

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	3
The development potential of UoA	4
OVERALL SCORE	3



OVERALL SCORE

The overall score is 3 due to some difference between the 4 departments: two are Strong International Players (NANOENGINEERING and MOLECULAR COMPOUNDS PHYSICS) and two Strong National Players with some international recognition (NUCLEAR RESEARCH and ENVIRONMENTAL RESEARCH).

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit Environmental and Chemical Physics includes 4 Departments: NANOENGINEERING, NUCLEAR RESEARCH, ENVIRONMENTAL RESEARCH and MOLECULAR COMPOUNDS PHYSICS. The Nanoengineering Department is studying nanomaterials formation, interactions with biomolecules as well as novel bio sensing platforms and its long-term plan is to add more modern biophysical facilities. The Nuclear Research Department deals with experimental nuclear spectroscopy, nuclear energy safety, radiation protection, radiochemistry, radioecology, and ion beam analysis and material modification, stable isotope ratio mass spectroscopy. The Environmental Research Department is developing competence in the fields of renewable energy sources, environment contamination and climate change investigations. The Molecular Compounds Physics Department is developing laser spectroscopy methods,

their application to the dynamic process in molecular compounds with the goal to create new elements of molecular nanoelectronics.

One has to notice that the 3 first departments are located slightly outside of Vilnius, the last one being in the centre. The Unit has 76 FTE researchers. From the documents available it is not obvious to see the links between the 4 departments (excepted for the Nuclear Research and the Environmental Research Departments). The scientific production is inhomogeneous. The nano-engineering Department is very well equipped for development and improvement of new nano-materials, structures and processes that are applicable to life sciences and medical technology, in particular, the non-standard, self-assembly based structure formation methods. It has developed reliable experimental platforms for research of macro-molecular structures, as well as bio-chips, bio-medical materials and their devices prototypes. During this development phase, the laboratory should not be judged on the publications (although there are 2 good publications in 2014) but on its capacity to create 2 successful spin-off companies and BALTFAB, a joint Open User Facility with the Laser Technologies Department at the Center for Physical Sciences and Technology, offering a full range of nano/micro and macro fabrication as well as laser patterning, marking and cutting on any required material.

The Molecular Compounds Physics Department has a remarkable scientific production with publications in high profile journals: Nature Chemistry, Nature Communications (2), JACS and a very strong theory group.

The Nuclear Research Department has no "important" publications in 2013 and the Environmental Research Department none in 2009, 2013.The Unit has many international collaborations with Universities or Institutes in the USA, Germany, Denmark, France, Ireland, Poland, Russian Federation, Italy, Sweden, Switzerland, Republic of Korea, and Taiwan. Among the 282 articles published during the 5 years period, 179 have international co-authors, which is very good. These publications have been made in good international journals or in high profile journals, depending on the Departments. The Unit has today about 20 PhD students. The Unit is a strong national player with a good international recognition. The situation is different for the Molecular Compounds Physics Department which has a high international profile and can be compared to excellent laboratories abroad. With so many international collaborations and European contracts, the number and the quality of publications in the Environmental Research and the Nuclear Research Departments should be increased.

The general score is 3 but it is clear that the Molecular Compounds Physics Department and the Nanoengineering Department are at a level of 4.

The economic and social impact of the research in Lithuania

At least 3 Departments are strongly involved with applied European projects or SMEs:

Nanoengineering Department:

-MEHTRICS (FP7): Micropattern-Enhanced High Throughput RNA Interference for Cell Screening, 2011/2014,

-METASENS (Swiss-Lithuanian collaboration): Aerosols in Lithuania, 2012/2016,

-It is also involved with 3 SME projects administrated by the Lithuanian Business Support Agency (LBSA).

Two spin-off companies, UAB Ferentis and UAB Erumpo, have been created. *UAB Ferentis was elected Best New Company 2014 at the European Life Science Awards in Barcelona. In 2013, the two Ferrantis founders, May Griffith (Linköping University) and Ramunas Valiokas (Head of the Nanoengineering) received the Nanomedicine Award in the regenerative medicine category at the Bio-Europe Conference in Vienna for a regenerative medicine-based treatment for Corneal Herpes Simplex Keratis.*The creation of BALTFAB, a joint Open User Facility with the Laser Technologies Department at the Center for Physical Sciences and Technology, offering a full range of nano/micro and macro fabrication as well as laser patterning, marking and cutting on any required material. It is part of the NANO

network (TECHNET), an international alliance of High Tech Facilities in the Baltic Sea Region. In 2014, it has submitted two patent applications and there is one in preparation.The funding of the Department in 2014 was 600 K€ (60 coming from the Unit)!

Environment Research Department

- With SMEs partners, EUREKA project BIOSOEX: Vehicle exhaust gas biosorbent filter, 2011/2014

- FP7 project TRANSFORM Transport related Air Pollution and Health Impacts, 2010/2014

- Emission studies of combustion processes with the joint-stock company JUMP.

- METASENS (Swiss-Lithuanian collaboration)

The Department has an US patent on "Method and apparatus for increasing the size of small particles" (2011).

Nuclear Research Department

FP7 RECOSY, EURISOL, CARBOWASTE, Decommissioning of Ignalina NPP, Decommissioning of Kozloduy NPP, collaboration with a SME on potential technology development concerning neutron sounding response in geological structures.

Molecular Compounds Physics Department

*A*lthough involved with basic science, it has developed a very nice CARS (Coherent Anti-Stokes Raman Spectrometer) which is commercialized by the laser company Ltd EKSPLA.

During the 5 year period, the Unit has obtained an annual average funding of 3672 k€, 2503 k€ are from international funding and 1155 k€ from industry: this is excellent.

The physical infrastructure of the UoA

The Nanoengineering Department has very modern equipment, especially if one includes the open access facility BALTLAB.

Environmental Research and Nuclear Research Department: there is good equipment but for some of them, a renovation will be useful but there is a lack of budget for that.

Molecular Compounds Physics: very modern equipment with everything necessary for femtosecond or picosecond spectroscopy.

The technical staff for the Unit is small: only 5 people. There are challenges in proper management of big financial resources provided by EU and we heard complaints about the bureaucratic routines of financing R&D in Lithuania. Not being part of a University, the access to databases and publications is limited.

Research management (including career development and human resource management) of the UoA

Nanoengineering Department: the department is based on experienced scientists who are head of divisions or research groups and guide young researchers in their early career; all the young staff are actively involved in international/SME projects. Written reports every 3 months help to structure the activities via self-evaluation and follow-up. There are 4 PhD students.

Molecular Compounds Physics Department: every year about 3/5 university students perform their diploma work in the laboratories. Senior researchers supervise 2/4 PhD students. There are 1 to 2 seminars every month where people of the department or invited lecturers give talks.

Nuclear Research Department: the best students are invited to continue in a PhD. Early career researchers are involved in ongoing activities in the Unit and receiving financial support. There are actually 7 PhD students.

Environment Research Department: early-career researchers (actually 7) are involved in all activities. There are 6 PhD students.

During our meeting with the students, the only complaint was about the lack of access to all journals due to the fact that the Unit is not in a University.

The long-term strategic and financial resource planning is adequate but in the case of the Nuclear Research Department the absence of a clear state energy development decision concerning the nuclear energy promotion in the country and the absence of a program for nuclear energy development are problematic: this means that long-term applied research in this thematic is very difficult.

The development potential of the UoA

The Molecular Compounds Physics Department has already an excellent international level. Its major task now is to determine the function-structure relationship of various biological and synthetic molecular systems to be able develop molecular devices.

The Nanoengineering Department is adding more biophysical possibilities of investigation and establishing an efficient technology transfer chain. For that a cell biologist expert has been hired recently. One of the objectives is the nanopatterning of biologicals materials. A very close collaboration with the leading regenerative medicine group ensures the clinical relevance to the nanobiomaterials research: there are very few groups in Europe capable of operating molecular nanolithography at the same level.

The Nuclear Research and Environmental Research Departments are covering an important area for Lithuania and with the recent investments they have a large development potential: both have a long term research plan, Environment-friendly power engineering and environment protection technologies. The situation is different for the Nuclear Research Department due the lack of clear state energy development decision concerning the nuclear energy promotion in the country. However, the knowledge accumulated can be very useful in environmental research and in the biomedical-biotechnology field.

The age pyramid of the Unit is very good and the number of PhD students is an investment for the future.

The Unit has shown its ability to raise good budgets. It assesses very well its strengths and weakness, variable in the different departments.

Conclusions and recommendations

As we pointed out already we see good links between the Nuclear Research and Environmental Research Departments, less between the others. The Nanoengineering and the Molecular Compounds Physics Departments are Strong International Players while the Nuclear Research and the Environmental Research Departments are Strong National Players with some International Recognition.

The positive part is the fact that the Unit has the will and the capacity to obtain good budgets.

The Nanoengineering Department should increase its list of publications: this is very important for the career of the students

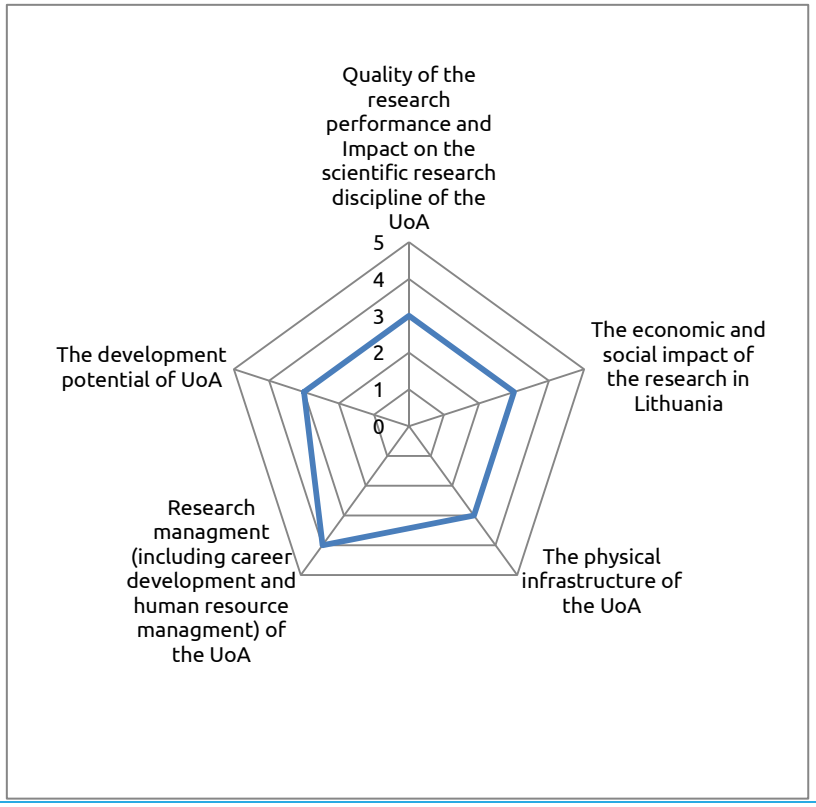
The Nuclear Research and the Environmental Research Departments should increase their collaboration (already existing) and increase their scientific production.

There is a necessity to hire some good engineers.

Natural sciences, Lithuanian University of Educational sciences

Name of the UoA	Natural sciences
Name of institution being assessed	Lithuanian University of Educational sciences
Total no. FTE researchers	23,2
Composition of the Unit of Assessment (UoA)	Natural Sciences

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	4
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

The Unit's research is generally of a high national and international standard, such as the work in ferroelectric semiconductors and mechatronics. In the area of entomology and insect ecology there has been a large number of species (ca 500) discovered and classified. The Unit is a very good player at the national level and at a good level internationally in above-mentioned areas.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The main research directions of the Unit are: biological diversity and natural processes, Studies of human organism adaptation to different physical activity and science and technology research. There are a number of smaller research topics. The research fields span from biology (35%), physics (17%), mechanical engineering (17%), informatics, geography, mathematics, medicine to chemistry (3%).

The number of staff in FTE is 23, at the same time the number of persons employed is 77. Some of the research is of a high national and international standard such as the work in ferroelectric semiconductors and mechatronics. The latter has resulted in patents being established. In the area of entomology and insect ecology there has been a large number of species (ca 500) discovered and classified. This work seems to be pursuing an original approach and is contributing at the international level and has good contacts with the international community working in this area.

The output of the Unit in both quantitative and qualitative terms exceeds the national average and reaches a good international level. Not only is there a steady stream of mid-level publications but this is positively accentuated by high impact journal publications. The relative output per researcher (7, 6 per researcher; total 212 in 2009-2013) and in terms of funding received is relatively high. Also, the funding for support activities (research visits, student visits etc.) is high to very high, for example in 2013 – 180 000 Euros. However, the industry funding is low or missing. There is a good list of international collaborations and the Unit has good potential to further improve in this area.

The economic and social impact of the research in Lithuania

There are not many research or development project interactions with local society or industry for a Unit of this size. Usually the projects are small (300 – 13 800 Euros), but enhance the Unit's visibility in Lithuania.

Six international cooperation projects are listed (funding between 1 160 to 8 760 Euros). Two patents have been established based on the electric linear motor research and one based on cancer tissues, which is commendable. There are a large number of activities, which involve board memberships of local societies and associations. As a part of the educational university, the central societal impact of the Unit comes from the delivery of primary and high school teachers for Lithuanian schools.

The physical infrastructure of the UoA

The infrastructure is described and seen as good with individual facilities as well as a number of specialized laboratories. Although the SWOT analysis gives as a weakness 'insufficient facilities for scientific research', there is always a lack some instruments, but in the case of this Unit, research partners' facilities have been used.

There is access to a cluster based computer and library facilities. The equipment used for the ultrasonic piezo-mechanical work has a good track record going back over a decade and is on a par with other such laboratories engaging in similar research. The proportion of support staff in the Unit seems appropriate. The buildings are old but rooms seem to be in good conditions. There is also a "palm house", integrated with tropical research. A modern auditorium for instructing the computer-aided classroom teaching techniques bridges the science and educational part of the Unit and is important pre-requisite for modern teacher's education.

Research management (including career development and human resource management) of the UoA

The age pyramid is somewhat tilted towards 55-64 (25 persons), against 35-44 and 45-54 groups have both 17 persons. The number of professors and associated professors has slightly decreased lately (ca 30 in 2011 to 22 in 2013), the same trend is visible for technical personnel. There is an eight-year outline research strategy plan with a shorter term more specific plan for the each sub-unit.

There is a document detailing qualifications and requirements for a researcher thus helping with career development. The number of doctoral students is low and none are enrolled from outside the University, but considering the main focus of the University (preparation of teachers), this low number can be justified. The PhD students were very enthusiastic and they all receive very good supervision and are internationally active, both in conferences and fieldwork. There is also a clear trend to publishing theses in English. The University seems to support the Unit' needs and research plans. As for the future, the Unit needs strengthening by junior and middle level researchers and rejuvenation.

The development potential of UoA

There are a large number of international contacts, leading to joint projects and publications (Japan, Korea, USA and others). These international contacts can lead to further extended and enhanced research activities. The funding from the State budget has increased if comparing years 2012 and 2013, from 457 000 Euros to

602 000 Euros. This is positive since in many cases the State funding has considerably decreased in Lithuanian research organizations and universities lately. It needs to be mentioned, the funding for support activities (research visits, student visits etc.) is high to very high, for example in 2013 – 180 000 Euros. However, the industry funding is low or missing. The studies in piezo systems in mechatronics, ferro-electric semiconductors, nanohybrids, biodiversity, entomology and insect ecology will be most likely important players in research in Lithuania and abroad and need to be further supported and developed. Increasing the number of PhD and Postdocs positions is essential to keep these research directions in good shape.

Conclusions and recommendations

The Unit's research is generally of a high national and international standard, such as the work in ferroelectric semiconductors and mechatronics. In the area of entomology and insect ecology there has been a large number of species (ca 500) discovered and classified. There are a large number of international contacts, leading to joint projects and publications (Japan, Korea, USA and others). The age pyramid is somewhat tilted towards 55-64 (25 persons), against 35-44 and 45-54 groups have both 17 persons. As for the future, the Unit needs strengthening by junior research staff. The infrastructure is described and seen as good with individual facilities as well as a number of specialized laboratories. The industry funding is low or missing. There is a good list of international collaborations and the Unit has good potential to further improve in this area.

The Panel recommends:

To pursue research in the established research directions.

To promote more industry contacts and joint projects in order to increase funding and extend national and international visibility.

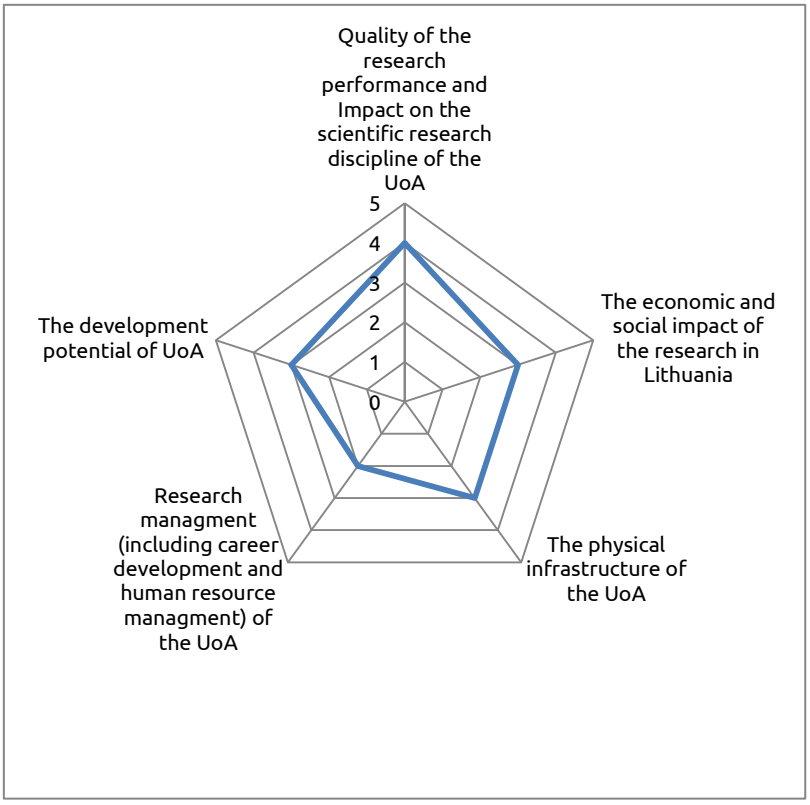
The teaching load of some professors and associate professors seems to be too high, some re-organisation of those loads is necessary.

The integration of younger researchers (by integrating PhDs and Postdocs) is required to ensure sustainability.

VU Institute of Theoretical Physics and Astronomy, Vilnius University

Name of the UoA	VU Institute of Theoretical Physics and Astronomy
Name of institution being assessed	Vilnius University
Total no. FTE researchers	49,5
Composition of the Unit of Assessment (UoA)	Astronomical Observatory; Department of Theory of Atom; Department of Theory of Nucleus; Department of Theory of Processes and Structures; Planetarium

Quality of the research performance and Impact on the scientific research discipline of the UoA	4
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

The research in physics is theoretical and the Unit is biggest of its kind in the Baltic counties. It has the highest H index of all the evaluated Units and the number of citations/article shows the top figure as well. Many papers have been published in highest level topical journals (e.g. PRL) and also in high impact factor non-topical journals (e.g. Nature Communications). The economic impact is modest, as the Unit has no patents, prototypes or spin-off companies. This is because Unit concentrates on the basic research. The Unit maintains a planetarium and has advocated the importance of basic science in Lithuania. The Unit operates the largest telescope in Nordic countries. The number of the PhD students is low. The main mission of the Unit remains somewhat unclear. The Unit has potential for development to the higher international level, provided a clear strategic focus i.e. mission would be developed and more active and high level PhD students were enlisted.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The research in the Unit concentrates on the theory of atoms and on the structure and evolution of stars and galactic systems. The research in physics is theoretical and the Unit is the biggest of its kind in the Baltic counties. It has the highest H index of all the evaluated Units and the number of citations/article shows the top figure as well. The number of original articles in anonymously refereed scientific journals cited in

SCOPUS has increased steadily from about 40 in 2009 to more than 125 in 2013 with a total of over 1 per FTE. Many papers have been published in highest level topical journals (e.g. PRL) and also in high impact factor non-topical journals (e.g. Nature Communications). Twelve presentations were given in international scientific meetings outside Lithuania. The Unit has a lot of activities to popularize science in the field of astronomy. However, the number of doctoral thesis awarded is low.

The economic and social impact of the research in Lithuania

The Unit mainly concentrates on basic research. Annually there are few doctoral thesis. This is probably the correct number if most of them would stay at the Institute. The Unit has no patents, prototypes or spin-off companies. This is because Unit concentrates on the basic research. The Unit maintains a planetarium and has advocated the importance of basic science in Lithuania. In addition, the Unit has social impact via its members serving in national scientific committees. The Unit has received quite modest EU funding. A fair number of conferences and workshops have been organized in Vilnius. Typically a basic research institution does not have immediate economic or social influence on the society. But anyhow the experience has shown that the accumulated good knowledge is usually important even outside the specific field of the institution.

The physical infrastructure of the UoA

Because of the theoretical nature of its research the funding level of the institute is rather low when compared to the corresponding foreign institutions having more experimental activities. The Unit operates the largest telescope in Nordic countries, this being the main experimental facility. It has some computational resources, which however could be of higher quality. Also the Observatory lacks maintenance funding. To focus on the theoretical research seems suitable decision taking into account the modest level of funding.

Research management (including career development and human resource management) of the UoA

UoA has the astronomical observatory and planetarium, and 3 theoretical departments. The main mission of the Unit remains somewhat unclear. The number of PhD students is low. It remained somewhat unclear how the research is organized in the Unit, i.e. is it based fully on dynamic research groups or on more static departments. Organisation of the management of research at the Unit of Assessment was rather traditional. During the visit there was one rather active person explaining practically all the questions raised by the reviewers. The long-term strategic and financial resource planning, including the human resource development strategy was missing. The human research management and allocation was explained at the rather general level. Positive aspect was the active international collaboration of students and post-doc with partners outside Lithuania, which seemed to be part of the every day research work. Staff complained that it is very difficult to buy even simple basic equipment (like pc and computers) needed in every day research work.

The development potential of UoA

In the global framework theoretical physics has had a rather good position and enjoyed until now rather extensive support from the expensive laboratories to which the theoretical research has been connected. Recently the situation has been changing due to e.g. competition from the environmental physics (climate change etc.). However, the Unit has potential for development to the higher international level, provided a clear strategic focus i.e. mission would be developed and more active and high level PhD students would join the UoA. Also, a dynamic research group based operation would be welcome, instead of the current individual researcher driven operation. The strong areas were related to the theory of the interaction of atoms with light as based on quantum mechanics.

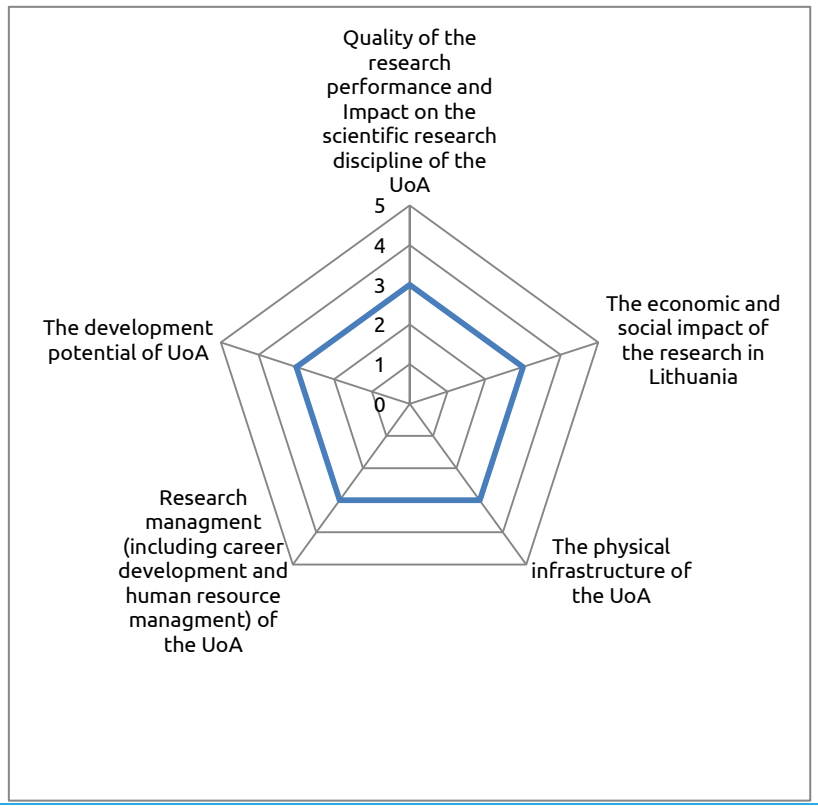
Conclusions and recommendations

It is recommended to raise the level of ambition to fully compete internationally with the best European groups in the selected research directions, which are the strengths of the Unit. This requires a careful strategic selection of the areas within which the institute can really compete. Also, it is recommended to significantly increase the funding from H2020. This requires a narrower focusing of the research activities and also a mission statement. Currently there is no clear focus of the future research direction and it remained unclear what are the goals, both scientific, economical and societal, of the research being carried out. It seems that the traditional research areas are being kept, and not much effort to think about changing the way of operation. To acquire more PhD students more visibility and clear future goals would be needed. Also, a dynamic research group based operating structure as well as clear researcher development track would be welcome. It is also recommend to invite visiting i.e. foreign scientist to work at the institute. Now the exchange occurs only to the opposite direction.

VMU Physical sciences, Vytautas Magnus University

Name of the UoA	VMU Physical sciences
Name of institution being assessed	Vytautas Magnus University
Total no. FTE researchers	13,63
Composition of the Unit of Assessment (UoA)	Faculty of Natural Sciences; Faculty of Informatics

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	3
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

The Unit has a number of fields of research ranging from biochemistry through to informatics. The Unit has some research activity in IT which is performing well at the international level. Overall the range of research activities for the Unit is assessed at the 3 level indicating that the Unit is a strong national player with some international research activity.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The main research topics listed are biochemistry, mathematics, informatics and physics with informatics being the dominant topic. The number of original journal outputs over the last 5 years is given as 39, 32, 38, 39, and 42 for a staff of 13.6 FTEs; this is an average output performance for the Unit. There were 20 important publications listed covering the range of activities of the Unit. Of these 5 were in the IT area and represented a range of publication locations, namely, a local Lithuanian publication plus two in the IEEE journal on intelligent vehicle systems with a further two making Fortran contributions in a software archival journal. The IEEE work makes a good contribution to the field of vehicle steering.

The Unit lists as its main research activities: biochemistry, cancer cell cultures; informatics, natural language processing and intelligent systems; mathematical analysis and physics plasma technologies and represent sub topics within the highlighted research areas above. There is a number of multidisciplinary projects,

particularly involving informatics, and informatics has attracted research funding from the European Union. For example, the Unit is participating in the EU Human Brian Project and has organised one of its summer schools. There have been 3 patents applied for in the assessment period in the physics/environment area. In addition a number of prototypes have been developed; the majority of the prototypes seem to be in the language processing area and linked to the Lithuanian language.

The economic and social impact of the research in Lithuania

The Unit is contributing to Lithuanian society through projects which involve energy security [in conjunction with NATO], analysis of voting results and heritage virtualisation sites. In addition there are a number of science in society events organised by the Unit, examples are a Researcher's Night and Spaceship Earth as popular science promotion events.

There are a number of projects with local industry listed, for example, radiotherapy treatment and speech recognition for pharmacy, and space monitoring for law institutions. There are also a number of international projects e.g. with a Hong Kong based company on a music tuition system. Other projects are listed but it is not always clear who the international partners are or what the impact or achievements have been. This is in addition to 3 patents mentioned above that has been applied for.

The research activities have led to five spin off companies having been established; all seem to come from the informatics research activities.

A number of the staff are acting as experts and evaluators both locally and further afield in a range of topics. Examples are The NATO Science for Peace Programme, Expert for the EU Marie Curie-Skladovka Research Actions, and expert at the European Science Foundation.

For a relatively small Unit it has a very good number of PhD students for the number of staff and size of Unit.

The physical infrastructure of the UoA

There is a range of equipment mainly, computer or biochemistry related, reflecting the various research activities - the equipment as well as being used internally it is also used externally by some local companies. There is a central library facility as well as access to electronic publications. There is limited computer equipment listed – a university server of 13 processors plus mention of additional cloud requested resources. This does not seem to represent a well-equipped laboratory for research activities requiring large computational resources. In addition, it appears that there is only one part time support technician which is inadequate.

Research management (including career development and human resource management) of the UoA

The Unit's research strategy is aligned with the University's strategy and other appropriate directives associated with the particular research activity, for example, national energy strategy.

Research clusters are the main entity for focusing and coordinating research and each cluster has its own research plan within the overall University strategy. A number of specific topics are listed as cluster topics – 10 in total – under the four main headings of Biochemistry, Informatics, Mathematics and Physics. Plans for publishing research results are the responsibility of the cluster and set on a yearly basis. The outputs are the standard outlets such as journal publications, conference proceedings etc. Multidisciplinary activity seems to be a main aspect of the clusters' activities. Most of the basic research seems to be in the area of physics, mathematics and biochemistry. There are specific initiatives to train early career researchers such as summer schools and a PhD Student conference.

The development potential of the UoA

The Unit has a number of ongoing projects which are well established and the researchers are publishing and attracting some external funding which has been erratic over the years. The additional funding question response concentrated mainly on supporting existing activities which are not adequately covered by existing available funds. There was no new proposals suggested for new research activities or initiatives.

In summary the Unit has a number of interesting and internationally relevant research projects and interacting with the local communities and further afield.

Conclusions and recommendations

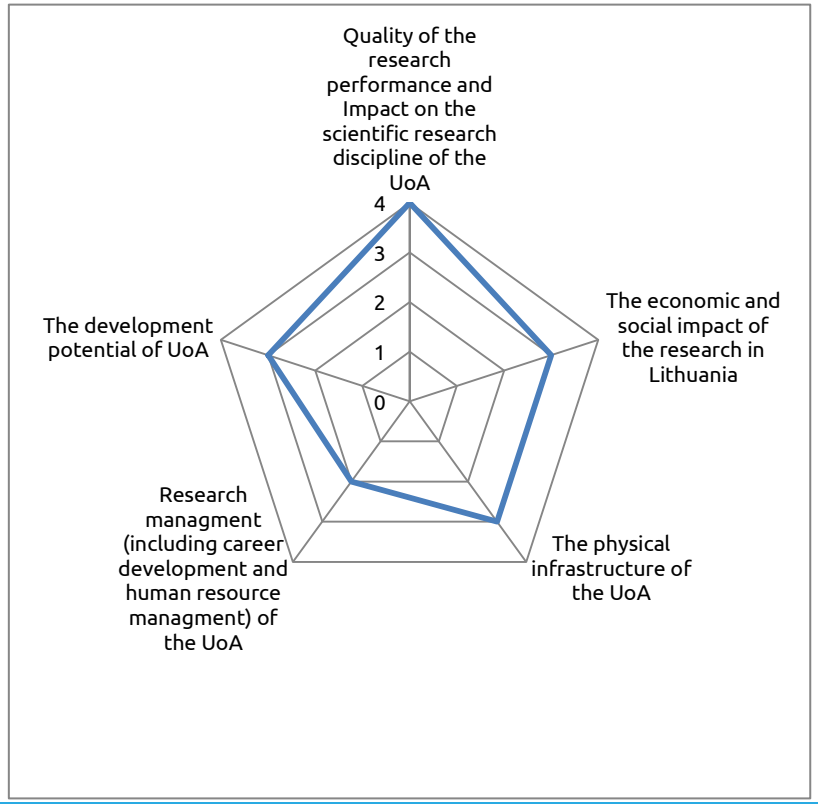
The Unit's applied research is quite diversified but the Unit has good international collaboration through EU projects. The research is fragmented across different disciplines with good individual research contributions and the research quality is better than the national average based on the statistics and has presence in the European research arena – the Unit produces more publications with less citations [low H index for the number of publications]. One problem is the size of the Unit consisting of only 13.6 FTEs which means it is too small to be a major international player; it would need to be strengthened in terms of staff and facilities. There is a research strategy in place as well as a system for the development of young researchers.

The Unit has developed a number of patents, developed a number of prototypes and interacted with the local community and industry to a certain extent. It has listed a large number of contacts both for research activities and visits which is encouraging. The disappointment is in the lack of attracting of external funding.

Faculty of Mathematics and Informatics, Vilnius University

Name of the UoA	Faculty of Mathematics and Informatics
Name of institution being assessed	Vilnius University
Total no. FTE researchers	38,89
Composition of the Unit of Assessment (UoA)	Faculty of Mathematics and Informatics: Department of Computer Science I; Department of Computer Science II; Department of Didactics of Mathematics and Informatics; Department of Differential Equations and Numerical Mathematics; Department of Econometric Analysis; Department of Mathematical Analysis; Department of Mathematical Computer Science; Department of Mathematical Statistics; Department of Probability Theory and Number Theory; Department of Software Engineering

Quality of the research performance and Impact on the scientific research discipline of the UoA	4
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

The overall assessment is of a Unit operating in part at the International Recognition level with a number of activities which could be further developed to improve the situation.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The profile of the Unit gives the overwhelmingly majority activity as Mathematics [70%] with 20% Informatics and a few other activities. The Mathematics research topics are predominantly number theory, probability, statistics etc. and differential equations and their applications. It is not clear why there are two Department of Computer Science sub units labelled 1 and 2 - the topic split seems arbitrary; there is also a Department of Software Engineering. The emphasis is on basic research.

The number of original articles published has been variable over the years, 85, 116, 95, 94, 91; this output publication rate is average for a Unit of this staff size 38.9 FTEs. The most important publications are primarily in international refereed journals. The studies on the Navier Stokes equations are one of the highlights of the Unit as well as the studies involving applications of stochastic methods. The number of

articles with a foreign co-author is not very high. There is single patent in solid state lamps which would appear to come from one of the minority topics of the Unit.

There is a list of cooperation and collaboration activities mostly involving research mobility with some project based; although the number of foreign visitors to the Unit is low. In some cases there is a lack of detail, for example, the software activity with CERN is not specifically described and would appear to be an important contribution to international activity. There are a number of projects with EU and national funding and involving many European institutions primarily in the IT sector.

The economic and social impact of the research in Lithuania

The Unit seems to have established an incubation facility for new companies in the IT sector although no details of the success or achievements of this facility were listed. There has also been projects which are technology transfer based with a Belgium company as well as local companies. Four spin off companies are given in areas of space technology, chemistry, sensors and big data.

A small number of the staff members are involved in primarily Lithuanian public sectors bodies such as transport, cybercrime etc. with a European Grid Infrastructure involvement although the details are not given.

The incubation and spin off activities are good societal activities for the Unit but the impact of these activities are not clear.

There is a reasonable number of doctoral thesis and an impressive number of Master degrees.

The physical infrastructure of the UoA

For the Unit's infrastructure there is a long list of mainly journals given plus a few items of equipment, for example, a supercomputer SK2 but there no details of what it is used for or what impact it has had on research activities. It seems the important infrastructure facilities are journals and databases in promoting research. However there is a plan to expand the use of the supercomputer [internally and externally] and also to develop grid and cloud computing facilities. It is not clear where the demand is for these latter facilities is coming from as it is not apparent in the research activities and outputs.

The annual funding of the Unit taking into account the number of researchers is low. The Unit has organised a number of conferences and meetings on its main research areas.

Research management (including career development and human resource management) of the UoA

There does not appear to be an overall mission statement plus objectives for the Unit with the strategy based on maintaining research topics that the Unit is strong with encouragement to apply for grants and reduced teaching load for active researchers. The head of department is responsible for the research plan within a Department. There is monitoring of PhD students and early career staff; there is a reasonable number of doctoral students enrolled 10, 8, and 11 over the past three years with a much larger number of Masters Students. Many of the theses are published in Lithuanian limiting the impact of the research.

The main thrust of the research is to address basic research but part of the research is regarded as applied. The existing structure seems complicated and therefore limits flexible and adaptability to topic change. Many of the researchers will retire in a relatively short time and in some cases existing research topics should be considered for change.

The development potential of the UoA

There is a number of research activities which are well founded and progressing well within the Unit. These activities have international involvement and attracted competitive funding from internal as well as external

sources. There is also a reasonable number of PhD student enrolments on which to develop the future activities of the Unit. However the research strategy plans do not appear to be well specify or coordinated across the research topics and the career development strategy plans are also not well documented.

The reaction to an increase in funding is to create a new research fellow's position to attract researchers and to fund early career positions there was nothing mentioned in new areas or activities.

More specifically, there are a number of international collaborations, mainly, through researcher mobility activities plus a few research projects linked to one member of staff. There has been a sizeable number of visits abroad which have involved a number of countries both within and outside the EU, however, the direct research benefits and /or grant applications as a result of the visits is not clear and more tangible benefits would have been expected.

The scientific environment seems to be adequate for the type of 'theoretical' research being performed but the ambitions for the computational science activities will need to ensure that the computing resources are continually updated and internationally competitive.

Many of the listed scientific topics/objectives, for example, cloud computing, computational modelling are highly competitive fields in Europe and further afield and have direct societal benefits. However, given the competitiveness of the field the UoA will require further investment and to develop new and innovative approaches.

The strengths and weaknesses, opportunities and threats analysis lists many problems which are also facing many UoAs outside Lithuania; there is little concrete information on how some of the problems are to be solved, for example, not active enough staff.

The staff breakdown gives a large majority in the Mathematics division and a minority in Informatics. There is an urgent need to increase the staff of the Informatics division and to create a national computing research unit which can lead both within the country and gain recognition outside Lithuania.

Conclusions and recommendations

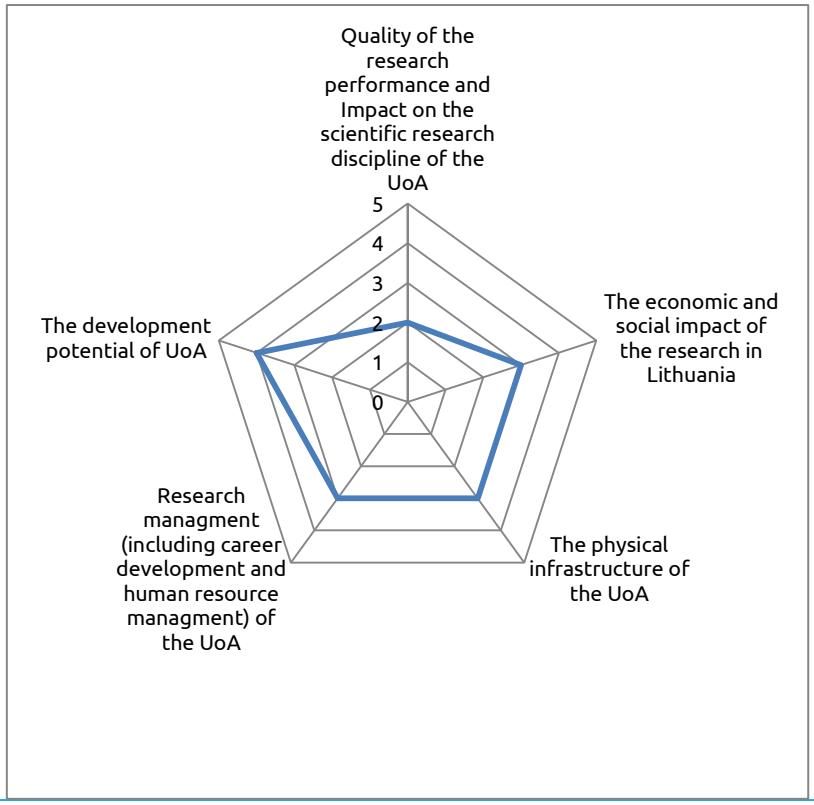
In general the quality of the research is good as reflected in the publications, international contacts and international competitive funding. The Informatics section of the Unit has many divisions with titles which do indicate the type or nature of the research being performed and that needs to be addressed. The management and presentation was informative but the research management does not have a clear mission statement and objectives. The research management structure seems complicated and could be simplified.

The future of the Unit seems promising as a critical mass has been achieved in at least three areas and there are a lot of young researchers which underlines promising development potential. The Informatics section of the Unit is not as well developed as Mathematics section and given that the Institute of Mathematics and Informatics has complementary skills and activities discussions on a merger are recommended.

Institute of Chemistry, Center for Physical Sciences and Technology

Name of the UoA	Institute of Chemistry
Name of institution being assessed	Center for Physical Sciences and Technology
Total no. FTE researchers	89,6
Composition of the Unit of Assessment (UoA)	DEPARTMENT OF CHEMICAL TECHNOLOGY; DEPARTMENT OF ELECTROCHEMICAL MATERIALS SCIENCE; DEPARTMENT OF CATALYSIS; DEPARTMENT OF CHARACTERIZATION OF MATERIALS STRUCTURE; DEPARTMENT OF ORGANIC CHEMISTRY

Quality of the research performance and Impact on the scientific research discipline of the UoA	2
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	3
The development potential of UoA	4
OVERALL SCORE	3



Overall score

The Unit has a focus on materials science, especially on electrochemical aspects and material structure characterization. It has good quality equipment, some being state-of-the-art. Some research group are truly competitive internationally. The Unit receives significant funding from the industry, which does not produce high level scientific results i.e. high quality papers. The Unit participates in joint doctoral degree-granting program with Vilnius University. With a higher ambition level to publish in good level journals and with the development of a narrower research focus, the Unit has potential to develop to the competitive international level.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit has 5 departments: chemical technology, electrochemical materials science, catalysis, characterization on materials structure and organic chemistry, with 89 FTEs. There are 7 main topics of research and development listed in the Unit's report. The Unit's quantitative research output is at the reasonable national level. However, the Unit has only a few midlevel international publications, main publications being at the lower level topical journals. Also, there is a low level of internationalization (co-authors) and a low relative output per researcher and especially in relation to the funding received. Only 14

presentations were given in international scientific meetings outside Lithuania. One scientist has been active in the editorial boards of international journals.

The economic and social impact of the research in Lithuania

The Unit has received 7 patents, originating mainly from the group very active in electroless deposition and catalyses. Some of these patents have these been licenced to a US company. No spin-off companies were initiated. Recently one group in the Unit has joined a H2020 project in the field of tribology with 0.6 M€ funding received. The Unit receives significant funding from industry for carrying out service work to companies.

The physical infrastructure of the UoA

The Unit has really modern equipment for material characterisation based on x-rays. Thin film deposition equipment included an ALD reactor as well as physical deposition tools based on RF and magnetron sputtering. Also, quite standard electron beam based equipment including SEM and non-Cs-corrected i.e. standard 200 kV analytical TEM, and also modern equipment for electrochemical studies like e.g. fuel cell testing. There were reasonably modern equipment for electrochemical studies as well as those for corrosion related research. Chemical analyses equipment included ICP-OES and HPLC with several detectors. However, the equipment were tuned towards service work for industrial partners, accordingly they did not seem to be fully utilized in the academic scientific research aiming at novel results to be published in high impact factor international journals.

Research management (including career development and human resource management) of the UoA

Some part of the research is carried out in active research groups, being led by a senior scientist with post-docs and PhD students joining the group. These groups seem to have clear research goals. The service type work is carried out in the departmental structure. The strategic plans of the Unit are at the general level only. It is not clear what is mission of the Unit as a whole. The Unit participates in joint doctoral degree-granting program with Vilnius University.

The development potential of UoA

The Unit receives a significant amount of industrial funding, however this funding does not end up in publishing high quality scientific papers in most cases, the exception being a couple of active research groups. The Unit also has good quality equipment. However, in general the researchers do not have the ability to reach the competitive international level. Also, the ability to initiate new research directions was not observed. Similarly, the future vision seemed to aim at service work, not on high level research on novel topics, aiming at high impact factor publications with international visibility. We found reasonable number of active PhD students, but this number should be higher. The unit is unlikely able to attract high level scientist from outside Lithuania. The level of competitive international research funding is low, indicating that the unit is not capable of joining promising international research projects. With further narrowing of the research focus to the areas important for industry in Lithuania and with adapting to a dynamic research group based management, there is significant development potential.

Conclusions and recommendations

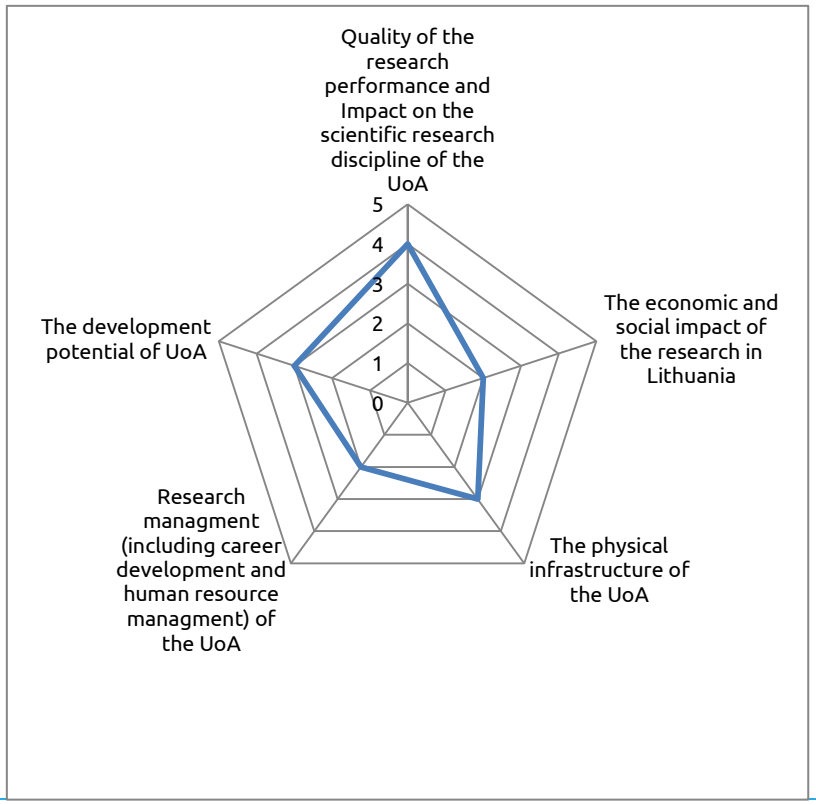
The Unit has good quality equipment, some being state-of-the-art. Some research groups are truly competitive internationally. The Unit receives significant funding from industry, which does not produce high level scientific results i.e. high quality papers. The number of both Master and PhD thesis awarded per chief and senior scientists is low, and more active PhD students are needed. It is recommended to adapt a dynamic research group based structure in the Unit's management. With the higher ambition level to publish

in good level journals and with the development of a narrower research focus, the Unit has the potential to develop to an international level competitor.

Faculty of Chemistry, Vilnius University

Name of the UoA	Faculty of Chemistry
Name of institution being assessed	Vilnius University
Total no. FTE researchers	33,56
Composition of the Unit of Assessment (UoA)	Faculty of Chemistry

Quality of the research performance and Impact on the scientific research discipline of the UoA	4
The economic and social impact of the research in Lithuania	2
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

The Unit is well positioned to act as the national centre for chemistry research. Despite being located in an older building the UoA is well equipped and has excellent facilities. The Unit delivers high quality research, works well together and has motivated students. It has minor deficiencies in management, strategic planning and social impact. Overall, a well-run, pleasing place, which delivers good value for money for Lithuanian society.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The UoA is relatively small in the international context but delivers good value for money. The output of the Unit in both quantitative and qualitative terms exceeds the national average significantly and reaches international level. Not only is there a steady stream of mid-level publications but this is positively accentuated by high impact journal publications such as Angewandte, Nature Chemistry, JACS, etc. The relative output per researcher and in terms of funding received is the second highest in this assessment exercise and is close to good mid-level, international institutions. There is a good list of international collaborations and the Unit has significant potential to further improve in this area. The only negative is the low level of present external funding.

The economic and social impact of the research in Lithuania

The main contribution to society has been the delivery of a significant number (for the Unit's size and funding) of Ph.D. graduates. The Unit lists its activities with other societal sectors as "N/A", while in reality it has social impact via significant positions of trust, both domestic and international. While the Unit has good plans and a clear idea of what is required this has not translated to a significant degree into relevant economic impact. Nevertheless, the Unit has a decent number of contract research projects. This section is the weakest aspect of the Unit and needs improvement.

The physical infrastructure of the UoA

UoA is located in an old building with several sections having been renovated (although no efforts have been made to provide disabled access). Most of the individual laboratories are completely new, while the older ones are well maintained and in excellent order. The instrument base is adequate and sufficient for its present operations and the main concern of the Unit is the need for support in research management. A large number of the instruments were recently purchased and are in good order. Plans for the future, e.g., integration of some Units in a nanotechnology centre, or perhaps a new building, have not yet matured.

Research management (including career development and human resource management) of the UoA

The Unit has plans and strategies for most areas. While one can argue about the content (some overlap too much with other institutions), the need for such plans has been recognized and some aspects (concern for young staff members, increase in number of females, etc.) are noteworthy and unique in the Lithuanian research landscape. With adequate academic leadership this could be improved further (see comment in SWAT analysis on "weak linkages among the different researchers"). Primarily, an overall strategic plan for the whole Unit is needed with some streamlining of the many research areas. Some deficiencies in management were encountered: no detailed knowledge about research income, cumbersome administrative procedures.

The development potential of the UoA

The Unit has delivered good work, and with further narrowing and selection of the topics to be focussed on via adapting research group based management structures has the potential to develop into a high level international research centre. The quality and motivation of the Ph.D. students is good, quality of research is excellent, international contacts are present and only need to be strengthened. While the infrastructure is adequate this Unit, more than many of the others, would benefit from a new building. However, the intake in external funds must be improved (it is rather weak even in the national context) as should be its interaction with society and industry must be significantly improved as well. Notably, the UoA has excellent teaching laboratories, a base requirement for the national research efforts. This Unit can well serve as the nucleus for a larger unit on chemical research.

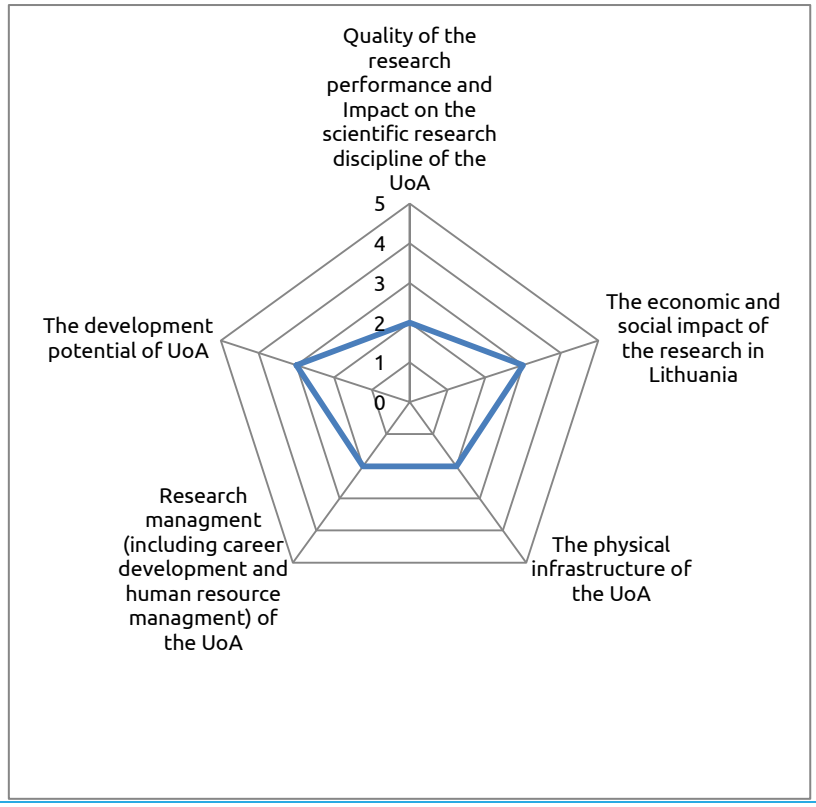
Conclusions and recommendations

The Unit works well and delivers high quality research. It is well organized with new instrumentation and good students. It has some deficiencies in management and lacks an overall strategic approach and it has to improve its external funding. Individual research groups are internationally recognized and thus there is no reason that the Unit cannot improve to that of a strong international player. The Unit should not be fragmented in future building plans. It works well as is and its collegial atmosphere and success should be further strengthened.

Faculty of Natural Sciences - GEO, Vilnius University

Name of the UoA	Faculty of Natural Sciences - GEO
Name of institution being assessed	Vilnius University
Total no. FTE researchers	13,81
Composition of the Unit of Assessment (UoA)	Department of geography and land management; Department of hydrology and climatology; Department of geology and mineralogy; The centre for cartography; Department of hydrogeology and engineering geology

Quality of the research performance and Impact on the scientific research discipline of the UoA	2
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	2
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	3



OVERALL SCORE

There are low marks given in research quality, infrastructure and research management, however, the overall score was given "3", since there is a potential for development within the Vilnius University by much better research management and much clearer vision/mission definition for the future. Also, the sub-units are at different scientific/research and infrastructure levels. One example of the bad management was illustrated during the Panel visit – there was no one present from the Faculty or University administration. As it was clearly stated by researchers, they need more information about the future developments of the Faculty (will the Faculty be re-organised/split and how, etc.?).

Quality of the research performance and Impact on the scientific research discipline of the UoA

The faculty comprises 5 departments: Department of geography and land management, Department of hydrology and climatology, Department of geology and mineralogy, Centre for cartography, Department of hydrogeology and engineering geology. The sub-units cover geology, geography and sociology as mentioned research fields. The actual research topics range in a wide area from Precambrian geology, stratigraphy, environmental and landscape changes and differentiation.

The Unit has 12 professors, ca 19 associated professors and 13 lectures (2013). At the same time, the research staff working permanently is extremely small in numbers – 3.5 positions - which is too low to gain good internationally recognised impact and visibility in such broad field of research. The number of administrative personnel is 5.3 and technical staff is 14.65 positions, which is reasonable.

The total number of peer-reviewed publications in 2009-2013 is 112, which will in average give less than 0.5 publications per year per researcher position, this number is definitely very low and needs urgent significant improvement. Most of publications are in moderate level international journals. It is evident that the five different sub-units have quite different research impact at the national and international levels, however, there is no detailed data provided for the Panel to assess the sub-units quality.

There is a number of international collaborations finished and on-going, including Finland, Sweden, Estonia, Germany, Latvia, France, Poland and other countries. However, most of projects do not have any financial support. For example, in the budget the funding for the last three years in international R&D programmes comprises only 26,000 euros, which is not really noticeable for such a large Unit. The competitive research funding has decreased from 126,000 Euros in 2011 to 34,000 Euros in 2013, this causes very serious concerns and need attention. In 2013, five doctoral students were enrolled, 4 were graduated. There are no international PhD students nor Postdocs employed at the Unit. The number of PhD students is low and may cause trouble in preserving the sustainability of the Unit. The vast majority of the doctoral dissertations are in Lithuanian, which restricts the international visibility.

The economic and social impact of the research in Lithuania

There are topics which fit to modern society (public) needs, such as landscape and climate change and its social impacts and similarly georesources. The staff have participated in a number of international projects on those topics. There is extensive cooperation with a number of national small companies dealing with georesources, land management etc.

The funding from the national industry is very small (about 20,000 Euros in three years), as well the funding for support activities. As it was mentioned by researchers, in many cases the specialists have personal contracts and advisory deals with organisations and those contracts are not listed in the University book-keeping system. Some of the staff as well as PhD students work in companies (part-time) and a number of staff members participate in committees and editorial boards. According to the information provided it seems that the Unit has economic and social impact on the Lithuanian scale, while the international visibility is relatively low.

The physical infrastructure of the UoA

The physical infrastructure has somewhat been improved during the last few years, some EU structural funds have been used (ICP instrument). However, in general, the equipment is old and very basic, in most cases not providing enough support for high impact research. At the same time, there is research going on, for instance in geography and engineering geology units using these modest facilities. The list of equipment in SAR is in Lithuanian - a bit difficult to follow details, but based on the information obtained during the visit, most of the labs need urgently new basic instruments. There are access possibilities for more sophisticated instrumentation in other labs at the university or other universities and organisations in Lithuania. It has been stressed that there are too few technicians. Some of the rooms also need renovation; most rooms are in satisfactory conditions for teaching and research.

Research management (including career development and human resource management) of the UoA

This Unit was the only one during the Panel visits in Lithuania where no administration was met. Some information was given by the person responsible for the Self-Assessment Report, but the Panel lacked the details for general development strategies, budget etc. As it was clearly stated by researchers during the visit,

the staff needs more information about the future developments of the Faculty. It is not clear when and how the Faculty will be divided and what will be the future of Earth Sciences. The Unit has no clear vision about its position and opportunities after re-structuring of the University. The Unit does not have its own strategic development plan. They seem to follow the University development plan, which, unfortunately, was not clearly stated (not known) during the meeting with researchers.

The University has an administrative unit to help with international project applications, however, there are not many researchers applying for external grants. The age pyramid is moderately good, with the highest numbers of staff in age bracket of 35-44. Very low number of staff below 35 may be a concern for future sustainability. There is distinctive need to integrate more PhD students and research personnel, especially junior researchers. There is no international PhDs or Postdocs involved in the Unit's research, this is also concern. The lack of well-trained technical staff limits research. Moderate or low international visibility in terms of publications and international joint projects limits the Unit's attractiveness for young students and scientists.

The development potential of UoA

As the Vilnius University is the only university in Lithuania where geology, and hydrogeology and engineering geology are taught, it is very important that these sub-units show also excellence in scientific and applied research. This also requires modern basic equipment and infrastructure to support chosen research directions. All departments of the Unit have necessary foreign contacts, which sometimes result in joint papers. This is a base for future development opportunities. The Unit (5 departments) has 12 professors, 19 associated professors and 13 lectures (2013). The research staff working permanently is extremely small in FTE numbers – 3.5 positions - which is too low to gain good internationally recognised impact and visibility in such broad field of research and therefor is below critical mass.

Unfortunately, the Unit has not shown its full capacity to raise funds from the international programmes, industry and from other sources of funding. This mentality has to be changed and considerably better research management needs to be established. However, the number of teaching staff, the moderately good age pyramid build a strong (theoretical) basis for future development. The potential can be much better managed if the Faculty of Natural Science will be re-organised in such a way that the Earth Sciences research fields will form a separate Unit with a clear vision and future development plan. The present status of Earth Science within the faculty is not capable to support the future developments.

Conclusions and recommendations

The Unit has not been active enough in using EU funds for equipment purchasing – it now needs more cooperation with already established laboratories and to use open access centres. The basic lab facilities need to be improved. The total number of publications is rather low and needs substantial improvement. The competitive research funding has decreased from 126,000 Euros in 2011 to 34,000 Euros in 2013, this causes very serious concerns. This relatively low funding may limit future developments. In many cases the specialists have personal contracts and advisory deals with organisations and those contracts are not listed in the University book-keeping system.

In 2013, five doctoral students were enrolled, 4 were graduated. There are no international PhD students nor Postdocs employed at the Unit. The number of PhD students is low and may present problems in preserving the sustainability of the Unit. The vast majority of the doctoral dissertations are in Lithuanian, which restricts the international visibility. The potential can be much better managed if the Faculty of Natural Science will be re-organised in such a way that the Earth Sciences research fields will form a separate Unit with a clear vision and future development plan.

The Panel recommends:

The restructuring the Faculty of Natural Science by separating Earth Sciences into a separate Unit.

Within the present 5 departments a debate should be launched about structural modifications, with the possible merge of sub-units into more compact units, for example, discuss the possibility of compacting (1) geography, hydrology, climatology and cartography; (2) geology, hydrogeology and engineering geology.

Start discussion about the possible merge (or of joint activities) of the Earth Sciences units of the Faculty of Natural Science and the Institute of Geology and Geography, Nature Research Center.

Use more extensively the existing laboratory facilities in Lithuania (in “Technology Valleys” and Open Access Labs).

Increase the number of PhD students, Postdocs and junior research personnel.

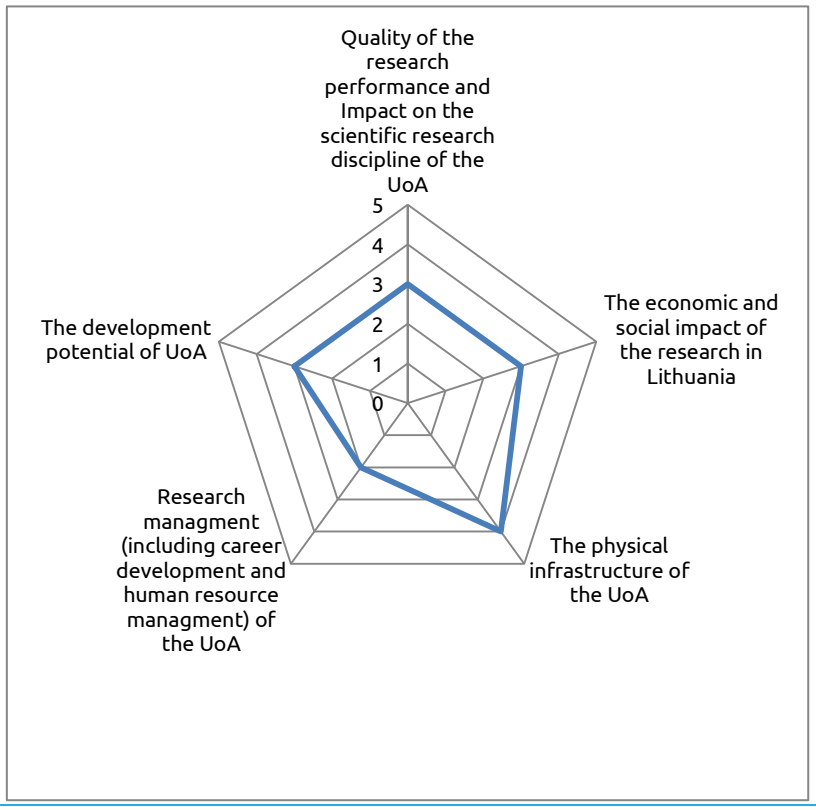
Be more active in pursuing international grants and joint research activities.

Increase the number of publications.

Institute of Biochemistry, Vilnius University

Name of the UoA	Institute of Biochemistry
Name of institution being assessed	Vilnius University
Total no. FTE researchers	61,38
Composition of the Unit of Assessment (UoA)	Department of Bioanalysis; Department of Bioelectrochemistry and Biospectroscopy; Department of Biological Models; Department of Bioorganic Compounds Chemistry; Department of Molecular Cell Biology; Department of Molecular Microbiology and Biotechnology; Proteomics Centre; Department of Scientific Information; Department of Xenobiotics Biochemistry

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	4
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	2



OVERALL SCORE

A large research institution, the Institute of Biochemistry covers several areas of cutting edge research topics, esp. in proteomics, molecular biology, screening and bacteriophage, bioelectrochemistry and microbiology. With good infrastructure and excellent instrumentation the Unit could deliver much more and is hampered by lack of vision, management problems, and unmotivated personnel. Economic and social impact is lower than in other Units. Strengths are the quality of the Ph.D. students, the pending transfer to the Center of Life Sciences, and existing industrial contacts.

Quality of the research performance and Impact on the scientific research discipline of the UoA

Modern research topics are present and individual contributions are good. The quantitative output is acceptable for the national level but is not highlighted by high quality publications in high impact journals. The Unit falls short in qualitative terms of what is required even for a nationally competitive institution. There are a good number of international collaborations and interactions with industry although levels of external funding are low. Some departments (*e.g.*, Bioorganic Compounds Chemistry) are primarily active in service contract research, which leaves almost no time for research activities. Almost no international

funding is reported and grant applications in this area were considered as “too much work” by the Unit’s personnel. The Unit’s potential is not used in terms of quality of performance. The direct "competitor" for this Unit is the VU_BTI which has the same problems but fares better in overall comparison. There is some overlap of research areas with other institutions in Lithuania.

The economic and social impact of the research in Lithuania

The Unit is active in local policy institutions and has a long list of commercialization activities and contract research. These often involve simple chemical syntheses of precursors instead of research oriented applied projects. Notable activities are in the area of enzyme screening and technology and biosensors. The UoA has a low number of Ph.D. students. Social impact is very small; there are no outreach programs or involvements in policy development. There is more potential for economic impact, but this requires a focus on technology development and transfer instead of acting as a simple service facility for industry.

The physical infrastructure of the UoA

The infrastructure of the UoA is good and present instrumentation is adequate for the current level of activities in all modern research areas. Notable facilities are the proteomics centre and the animal facility. The Unit has the ability to provide open access instrumentation in several core areas of Lithuanian biological sciences. In part, this is also the basis from some of the contract research. Furthermore, the Unit will benefit from transfer to the Center for Life Sciences.

Research management (including career development and human resource management) of the UoA

Management is a problem. There are no clear HR, teaching, or research strategy plans. Rather a list of individual activities and alignments with governmental strategies is given. The Unit had not prepared for the visit. Still, young researchers are actively supported and the Ph.D. students are involved in the supervision of undergraduate and Masters level students. There are no proactive initiatives which originate from the Unit. This section falls short of expectations for a Unit of this size and funding. Problems exist in the current personnel structure, many of the researchers are unmotivated, lack vision and an underlying strategy and refused to consider Horizon 2020 applications, new initiatives; “why do more work?”. Students are good and individually well motivated but too few in number and had no knowledge of their research strategy.

The development potential of the UoA

The Unit delivers output of some relevance for the national economy and has the potential to deliver even more. The low qualitative output, the unimaginative description of plans and measures taken indicate a lack of focus and/or vision. This was reinforced during the site visit, which revealed a largely unmotivated and drifting workforce. Much more activity, esp. in attracting external funds and high calibre research visitors and/or post docs is needed. In part this might be alleviated through integration in the Life Science Center but with its present structure and composition the potential is very limited.

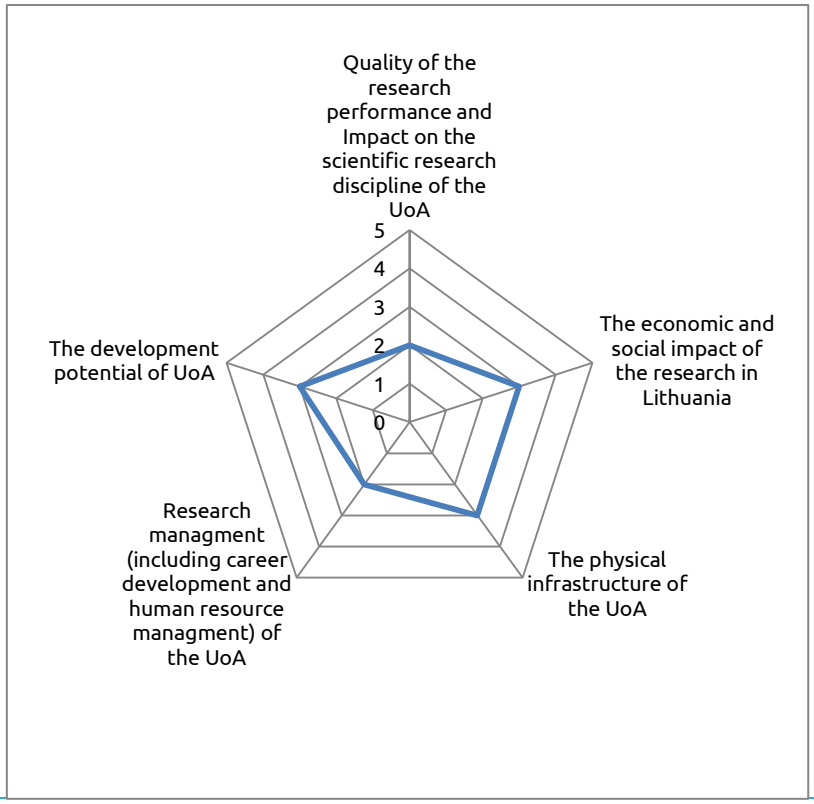
Conclusions and recommendations

Well equipped, with adequate staff numbers and targeting research of international relevance the Unit could deliver significant impact, but fails to do so. It is a drain on national resources and delivers no value for money. Individual researchers carry the Institute as a whole, while several departments only deliver service contract “research” at laboratory technician level. The latter is not the purpose of national research institutes. The research personnel is mired in a past which has long passed into the dustbin of history. The Unit must increase its external funding and the number of Ph.D. students and quickly develop a coherent and modern HR and research management strategy. Otherwise, the Unit should be shut down and the better performing groups be transferred to the Institute of Biotechnology (provided both will be better integrated into the University).

Material science, Center for Physical Sciences and Technology

Name of the UoA	Material science
Name of institution being assessed	Center for Physical Sciences and Technology
Total no. FTE researchers	105,7
Composition of the Unit of Assessment (UoA)	DEPARTMENT OF ELECTRONICS; DEPARTMENT OF PHYSICAL TECHNOLOGIES; DEPARTMENT OF FUNDAMENTAL RESEARCH; DEPARTMENT OF MATERIAL SCIENCE AND ELECTRICAL ENGINEERING

Quality of the research performance and Impact on the scientific research discipline of the UoA	2
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	3
OVERALL SCORE	2



OVERALL SCORE

The overall score is 2: this Unit could have obtained a grade of 3 but it is penalized by:

- A scientific production not corresponding to the large number of researchers. The Panel has not been able to find the active and not active groups because the Self Assessment Report does not give the publication list per scientist neither the names of scientists in the various groups and departments: obviously this can penalize the groups doing well.
- Too many topics of research for the existing budget, knowing that the Unit has not been very good to obtain funding from international R&D programmes (contrarily to many other Units).

A management that needs a reorganization.

A very small number of PhD students: this can be very negative for the future of the Unit.

A management that needs a reorganization.

Quality of the research performance and Impact on the scientific research discipline of the UoA

This Unit includes 4 Departments: Electronics, Physical Technologies, Fundamental Research, Material Science and Electrical Engineering. The main fields of research are: Applied Research in Materials

Engineering, Electrical and Electronic Engineering, Biology, Chemistry, Medicine and basic research in Physics with 17 main topics of research and development. The UoA has 129 persons employed but had a ridiculous small number of PhD students during the 5 years period, with a slight improvement now (8). It has many international collaborations with Universities or Institutes in the USA, Germany, France, UK, Russian Federation, Italy, Spain, and Switzerland.

Among the 449 articles published, 243 have international co-authors which is good. The twenty best publications have been made in good international journals with impact factor below 3.6 with the exception of two publications in Astronomy & Astrophysics (6.3 and 5.1).. However, the scientific production is inhomogeneous: it is clear that some of the groups are not very active and some others are doing well (this is even pointed out in the Unit Self-Assessment Report!). Only 14 presentations were given at international scientific meetings outside Lithuania. The Unit has to make efforts to increase its funding from international R&D programmes and industry funding. The laboratory is a strong national player with a good international recognition but needs to go a step further to be a real international player by reorganization, focusing of the activities and increasing seriously the number PhD students (as it is done in many other Units).

The economic and social impact of the research in Lithuania

During the 5 years, the following projects have been carried out with non-universities/research institutes:

2008-2009 Atmel Germany GmbH: Microscopic Investigations of Noise in SiGe heterojunction Bipolar Transistors for Compact Modelling.

2009-2010 Saint Louis Institute: 2DSA two dimensional array magnetic measurement module.

2011-2013 JSC Tamona: Development of frequency converter for advanced water supply systems.

JSC Geozondas: Joint project Nanoelectroevaporator for living cells BIONANOPORE

JSC EVOLIS: Joint project Development of magnetic field meter for electric power systems -MAGEPS

JSC Elgama-Elektronica: Joint project Nanostructured manganites films for energetics and high frequency electronics applications-MAGSENSAS

JSC Precizika MET SC: Joint laboratory for industrial photovoltaic technologies.

JSC Baltic Solar Solutions: Joint laboratory for industrial photovoltaic technologies.

With SMARTT Research BV (Netherlands) and Complex sp.z.o.o (Poland): Development of electronic odour identification system. FP7 project BOVINOSE.

With SwedClone AB and Biomol-Informatics (Spain): Proteins dynamic scaffolds for fabrication of self-organized nanostructures FP7-NMP-2012 SMALL-6 Stage 1

2012-2015 European Office of Aerospace Research and Development: Window for optimal frequency operation and reliability of 3 DEG and 2 DEG channels for oxide microwave MOSFETs and HFETs.

The total amount of funding for the 5 year period is of the order of 1200 k€ .This is positive but needs to be developed. The Unit has also built 13 prototypes, some have been sold to the French-German Institute Saint Louis and some to companies. The Unit has 2 European patents (Magnetic induction measuring apparatus having plural bands of thin films exhibiting colossal magneto resistance phenomena and Sensor system for monitoring wear) but spin-off companies have not been created.

We could not find in the report any information about the scientist participation in the popularization of their achievements in printed media, TV and on internet to increase the visibility of their achievements.

The physical infrastructure of the UoA

Actually the Unit is located in the building of the former Semiconductor Physics Institute in Gostauto Street 11. It has 8 specialized labs with very good equipment acquired during the last 4 years thanks to the financial support of the of the European Structural Funds (ESF). They seem to have a good computer network but the ICT software needs improvement. In the second half of 2015, the CPST will be relocated in a new building in Sauleteko Avenue (National Center for Physical Sciences and Technology). The number of m^2 available will be 20% smaller but that will be compensated by better laboratory supplies, hardware and software.

The Unit has no scientific databases, databanks or archives due to the defective science policy of the Ministry of Science and Education: only the Universities have access to internet and other scientific information resources; the students are complaining about this situation.

There are 18 technical people: this is rather good compared to other Units but the number of staff (3) in the administration is very small.

Research management (including career development and human resource management) of the UoA

Research Management is discussed rather briefly in the self-assessment report. The number of research topics is really large. It is not clear what are the synergy and collaboration activity between the 4 departments.

The age pyramid of the Unit is not very good with 46 people above 55 years. We have been astonished by the lack of reaction of the management to this problem. We observe a ridiculous number of PhD students in the period 2009/2013 with a small improvement in 2014 (8). This is difficult to understand knowing that 25% of the researchers (something very positive) are lecturers at the Vilnius, the Gediminas Technical and the Vytautas Magnus Universities in physics, material science, electrical and electronic engineering, informatics engineering and astronomy modules.. During the visit, we were told that this small number was due to a different timing between the Unit and the University. In view of the necessity to inject quickly new blood in the Unit, this is difficult to understand.

The long-term strategic and financial resource planning, including the human resource development strategy is very vague in the report. The vision of the Unit is to be one of the leading centres in Eastern Europe for research in electrical and electronic engineering, material science, chaos, synchronization, self-organization phenomena in nonlinear systems: this needs a serious reorganization of the Unit with well-defined short term goals and a strong reaction to the lack of sufficient number of PHD students.

The development potential of the UoA

It is clear that this Unit has a very good development potential but one has to be very careful. It has 8 specialized labs with very good equipment acquired during the last 4 years thanks to the financial support of the of the European Structural Funds (ESF). They seem to have a good computer network but the ICT software needs improvement. In the second half of 2015, the CPST will be relocated in a new building in Sauletekio Valley (National Center for Physical Sciences and Technology). The number of m^2 available will be 20% smaller but that will be compensated by better laboratory supplies, hardware and software.

The Unit has a large number of scientists that should be able to participate in international competition but this will be possible only if the Management presents a more detailed vision and plans for the future. The Unit assesses well its strengths and weaknesses, complaining about many subjects but one does not see any effort to correct that, for example by an aggressive action to correct the very low level of international R&D funding. As pointed out already the age pyramid is not very good and should be corrected by injecting PHD students as soon as possible.

Conclusions and recommendations

This Unit could have obtain a grade of 3 but it is penalized by:

- a scientific production not corresponding to the large number of researchers
- a management that needs a reorganization
- a very small number of PhD students

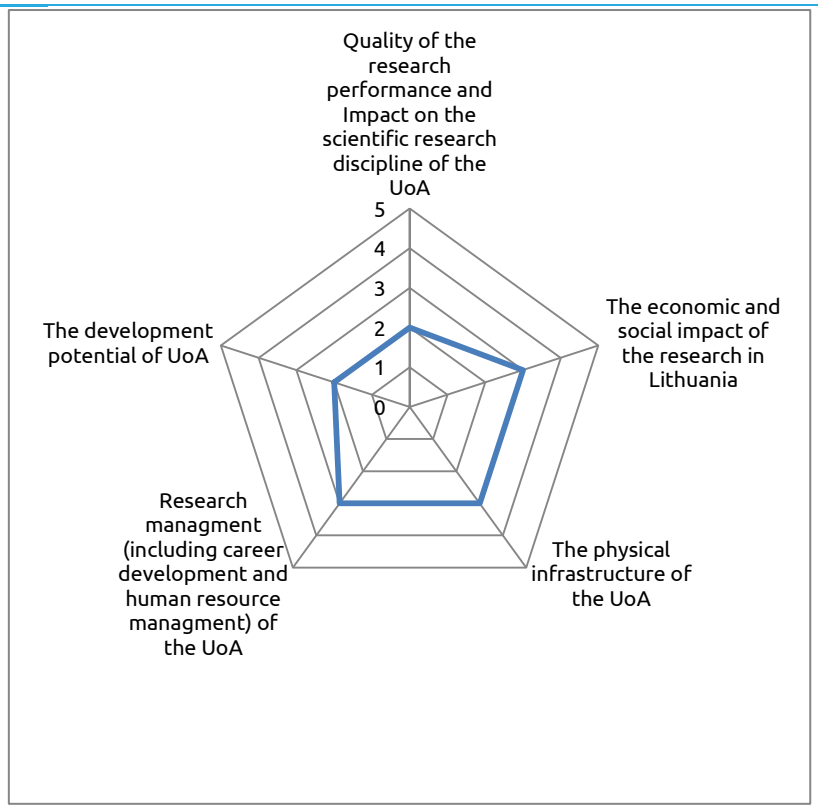
Recommendations:

- Increase the number of PhD students
- Refocus the subjects of research
- Increase the international funding
- Reorganize the Management of the Unit
- Improve the scientific quality of some of the groups
- Increase the number of publications in good international journals

Institute of Geology and Geography, Nature Research Centre

Name of the UoA	Institute of Geology and Geography
Name of institution being assessed	Nature Research Centre
Total no. FTE researchers	36,5
Composition of the Unit of Assessment (UoA)	Laboratory of Bedrock Geology; Laboratory of Climate and Water Research; Laboratory of Geoenvironmental Research; Laboratory of Nuclear Geophysics and Radioecology ; Laboratory of Quaternary Research

Quality of the research performance and Impact on the scientific research discipline of the UoA	2
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	3
The development potential of UoA	2
OVERALL SCORE	2



OVERALL SCORE

There are low marks given in research quality and development potential, while impact, infrastructure and management was marked at grade 3. The overall score 2 indicates primarily the low potential for the future if there will be no changes in publishing, research activity, and gaining international recognition.

Quality of the research performance and Impact on the scientific research discipline of the UoA

The Unit consists of 5 laboratories (as sub-units): Laboratory of Bedrock Geology, Laboratory of Climate and Water Research, Laboratory of Geoenvironmental Research, Laboratory of Nuclear Geophysics and Radioecology, Laboratory of Quaternary Research. The Unit's research covers more or less in equal proportions geology, geography and ecology/environmental research, with slight domination for geology.

There is no teaching staff, about 73 persons with total FTEs of 46,4 are employed as researchers and technicians. The number of peer-reviewed articles range from 11 to 33 per year with a total of 103 publications of 5 years. Considering the number of researchers (ca 32 FTEs), it will be less than 1 publication per year per the researcher. This is very low number, especially keeping in mind that the researchers have no teaching commitments and probably can fully focus on research. As a positive comment, the number of enrolled PhD students is high – 14 in 2013, but the number of awarded degrees is total is six

between 2011 and 2013. Only a few PhD students are employed as junior researchers. One out of six theses were written in English, the others in Lithuanian. There has been 3 Postdocs involved in research during 2011-2012, the last Postdoc ending in 2012.

There is a number of national (different universities, research centres and public organisations) collaborators, while international partners come from Latvia, Estonia, Poland, Denmark, Russia, Norway, Finland, UK, Sweden, Belarus and elsewhere. This is also exemplified by funding from national industry (ca 500 000 Euros for three years) and from international projects (354 000 Euros in year 2013, for instance). Also, the funding from competitive basis is high – between 193 000 and 270 000 Euros over the three years. The Unit's funding is in good shape compared to that of the Earth Sciences Units at Vilnius University. However, the scientific visibility and the number of publications are very low and is thus not matching with the relatively high funding. This is the main reason for relatively low grade for "Research performance".

The economic and social impact of the research in Lithuania

The Units shows moderate to good results in attracting commercial and international funding, for example, the funding from national industry comprises ca 500 k Euros in total for three years. The Unit has been involved in several international projects, for example FP7 projects CGS, CO2Stop, GEO-SEAS, EMODnet; IGCP projects No. 580, 567; Visby Programme, BioCold, NEPAL. One of the latest projects CLIMPEAT started in 2013. A number of researchers act as members of several committees and scientific advisory bodies, both in governmental organisations and business bodies. The industrial partners include companies like Geotestus, Rekya, Grota, DGE Baltic Soil and Environment, SWECO, Klaipeda Port. This suggests that the Unit has importance in the socio-economic life of Lithuania.

The physical infrastructure of the UoA

The infrastructure has somewhat improved during the last years. Both internal and external users use most of the equipment. The main equipment units include: Scanning Electron Microscope Quanta 250 with Oxford EDSand INCA analytical system; Low background gamma spectrometric system with solid-state photon detector ORTEC of GWL series, and some equipment for radionuclide studies and equipment related to specific sample preparation and geophysical instruments. Considering the wide spectrum of research, the infrastructure may not be sufficient for future studies, which suggest better integration with specific labs at the national and international level. As the number of the laboratory support staff is very limited and due to low international cooperation, the achievement of international visibility is problematic.

Research management (including career development and human resource management) of the UoA

Research Management is discussed rather briefly in the Self-Assessment Report. The number of research topics is large. It is not clear what the synergy and collaboration activity between the departments is. The Unit follows the 5-year activity plan. The Unit's age pyramid is tilted towards 45-54 and 55-64 age groups; rejuvenation is needed, integration of junior researchers is one way to secure sustainability. No Postdoctoral researchers are present at the Unit in 2013, but according to the report 3 Postdocs are related to the research groups (enrolled at different organisations, all related to geology).

The FTEs of senior researchers is 18,75, for researchers - 11 and for junior researchers 6,8. During the visit some PhD students reported some problems with acquiring data for the study and some difficulties in getting support to participate in conferences. The PhD students met during the visit did not seem to be the most enthusiastic compared to many other Units the Panel visited. Some researchers mentioned that the research sub-units are too fragmented and very little cooperation exists between the different sub-units.

The development potential of UoA

The potential for research development is also related to the researcher's age distribution, which needs rejuvenation, thus making the potential depending on it. The crucial point is the research funding and the potential to integrate into European or other type of international projects. However, there are staff members who show good integration into international projects and good publication output (based on publication list in SAR).

The funding from national industry (ca 500 000 Euros for three years) and from international projects (354 000 Euros in year 2013, for instance) is high if compared with that of the Earth Sciences Units at Vilnius University, for instance. The funding from competitive basis is high – between 193 000 and 270 000 Euros over the three years. However, while there are good aspects, in terms of industry and competitive funding amount, these are not translated into meaningful output. The fragmentation into sub-units and the lack of direct connection to the university students limits future developments. Also, the research fields are diffused, the number of topics is most likely too large to focus on a good quality, internationally recognised scientific and applied research outputs.

Conclusions and recommendations

The number of research topics is large. It is not clear what the synergy and collaboration activity between the departments is. The Unit's funding is in good shape if compared to that of the Earth Sciences Units at Vilnius University. However, the scientific visibility and the number of publications are very low and thus not matching with the relatively high funding. Considering the wide spectrum of research, the infrastructure may not be sufficient for future studies, which suggest better integration with specific labs oat the national and international level. As the number of the laboratory support staff is very limited and due to low international cooperation, the achievement of international visibility is problematic. The Units shows moderate to good result in attracting commercial and international funding, for example the funding from national industry comprises ca 500 000 Euros over three years. The potential for research development is generally below the average compared to other Units visited. The staff needs rejuvenation.

The Panel recommends:

Restructuring the Unit in order to get better in-house cooperation with a better focus on research topics, possibly by selecting most important and with higher quality projects and by closing up others.

Increase considerably publication activity.

Start a discussion about the possible merge (or other joint activities) of the Earth Sciences Units in the Institute of Geology and Geography, Nature Research Center and the Units working on similar topic at the Faculty of Natural Science, Vilnius University.

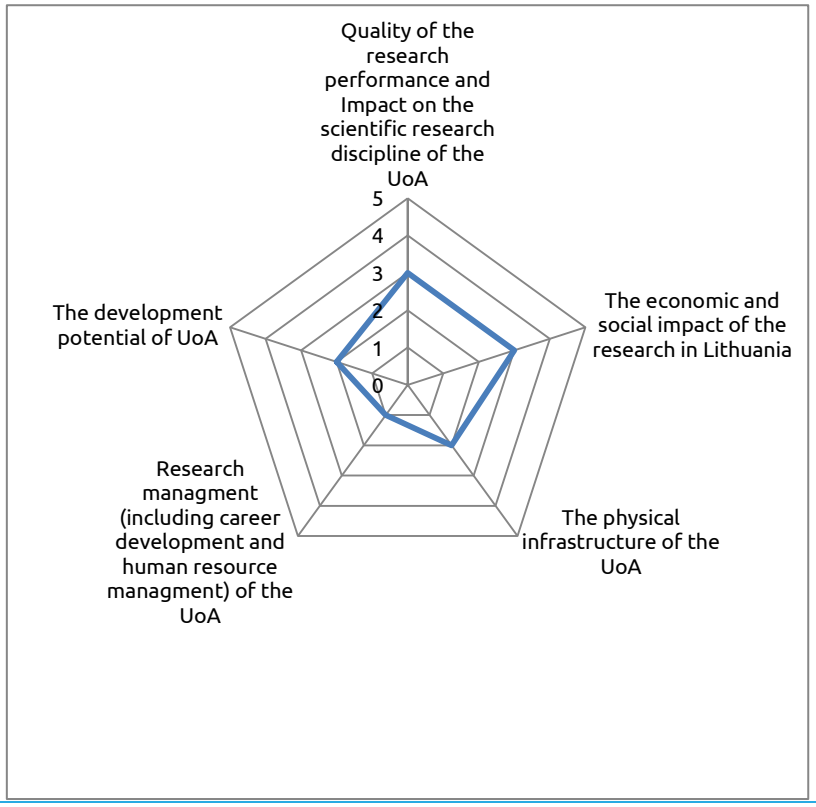
Use more extensively existing laboratory facilities in other locations in Lithuania (in "Technology Valleys" and Open Access Labs).

Increase the number of Postdocs and junior research personnel.

Institute of Mathematics and Informatics, Vilnius University

Name of the UoA	Institute of Mathematics and Informatics
Name of institution being assessed	Vilnius University
Total no. FTE researchers	50,8
Composition of the Unit of Assessment (UoA)	Department of Informatics Methodology; Department of Numerical Analysis; Department of Probability Theory and Statistics; Department of Recognition Processes; Department of Software Engineering; Department of Stochastic Processes; Department of Systems Analysis; Laboratory of Computer Networks

Quality of the research performance and Impact on the scientific research discipline of the UoA	3
The economic and social impact of the research in Lithuania	3
The physical infrastructure of the UoA	2
Research management (including career development and human resource management) of the UoA	1
The development potential of UoA	2
OVERALL SCORE	2



OVERALL SCORE

The Unit is performing well in the local context but needs a number of improvements in research management, external funding and publications to be internationally competitive.

Quality of the research performance and Impact on the scientific research discipline of the UoA

There are three themes listed as the main research topics, namely, mathematics, informatics and informatics engineering with a wide range of sub topics listed for informatics research. The research activity is described as both basic and applied which is reflected in the most important publication list. The outputs over the last years is given as 64, 68, 136, 157, and 110 in original journals which is average for the Unit's size of 50 FTEs. The H index has a high value 35 but there are few publications in top scientific journals. With a few exceptions the conferences and meetings attended are not the top meetings in the field.

The niche activities are given as a general list of topics with no specific achievements or impacts mentioned. The distinguishing features in comparison to international competitors is given as the combination of mathematics and computer science and working on big industrial projects; in the latter case specific details

are not apparent. The main scientific competitors are seen in countries nearby; certainly in the case of informatics this is not where the leading research activities are taking place.

The economic and social impact of the research in Lithuania

The main societal activity is given as joint projects using innovation vouchers although specific details of the impact are not clear. A number of software development projects involving transport, the Lithuanian language, data mining etc. are highlighted but again it is hard to judge the impact or the amount of effort or funding involved from the information given. Three spin off companies are listed but the impact is not detailed. The involvement of staff members as experts is mainly in Lithuanian based institutions and societies. There is good involvement with some of the international leaned societies such as IFIP TC, ACM SIG and EU networks.

The Unit has a good number of doctoral students. The Unit has organised a number of conferences but very few foreign researchers have visited at the Insure for long periods. Funding is mainly from the State budget with negligible funding from international R & D sources.

The physical infrastructure of the UoA

A long list of journals is given as the basis of the research infrastructure with a few items of equipment, namely. A long list of journals is given as the basis of the research infrastructure with a few items of equipment, namely, a cluster and a scanner. There is access to resources outside the Institute but sufficient details are not given in order to judge their deployment, usage or impact. The resources are described as sufficient research equipment and computer resources. The computer resources seem basic for some of the research topics listed, for example, grid systems and as a result would need to be developed in order to meet international norms in such research areas.

Research management (including career development and human resource management) of the UoA

The research strategy is given as a list of research topics or problems across the various research themes. There is a long term research trends plan produced on an annual basis and approved by the Council but there does not appear to be a mission statement plus objectives for the Unit or the individual research activities. The number of awarded Masters and PhD degrees is given as 14 and 19 for 2013 which is a reasonable number for such a Unit size. The vast majority of the theses produced are written in Lithuanian which greatly limits the impact of the research contribution in the international community.

The meeting with the researchers and PhDs was not organized in advance. For individual researchers there is a pay incentive. There does not appear to be a monitoring or early staff development programme.

The development potential of UoA

It is not clear how this Unit relates to another Unit, namely, Vilnius University, Faculty of Mathematics and Informatics. Not only do they have similar names but they also have an overlap in their research topics.

The majority of the collaborations are in the local region with a few international collaborations but the latter collaborations are mainly research training rather than substantial cooperation or outputs. Of the important international research collaborations listed there does not appear to be any of a substantial and sustained research or project development basis; as a result there does not appear to be a strong staff participation in international research. There have been a number of external funded projects over the years with one from the EU but for support activities, for example, Mathematics and Science for Life rather than research activities. There is a list of contract research with Lithuanian companies which is described in Lithuanian.

The main fields and topics of the Unit contain many areas which are being researched internationally and which have benefit to society, however, it is not clear how this Unit plans to make it presence felt in the international arena of such research activities.

The strengths and weaknesses, opportunities and threats highlight problems which are affecting many institutes in other countries. Overall there was not a clear plan as to how many of the problems are to be addressed, for example, the high average age of the staff, expanding collaboration within the EU. The high average age is problem which would need to be ungently addressed if the Unit is to become an internationally recognised centre.

Conclusions and recommendations

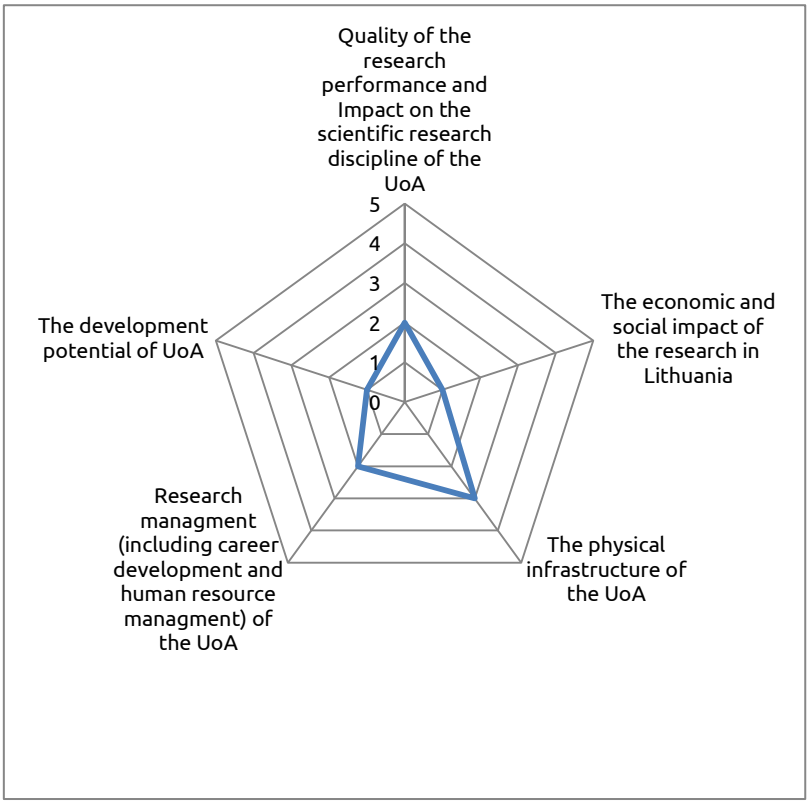
The range of topics particularly in informatics needs to be changed to obviously reflect the nature of the research activities. The management structure needs to develop plans and strategy based on international research norms. The Unit has a reasonable publication rate but could do better in high impact international journals. The Unit has a good number of PhD students which are of potential benefit to the information society within Lithuania. The ambition of the Unit outside Lithuania could be greatly improved.

The Unit has a range of Mathematics and Informatics activities with a majority of PhD students in Informatics. There is thus complementarity with the Faculty of Mathematics and Informatics in the relative strengths in the two main research topics, namely, mathematics and informatics. The initial assessment by the Panel is that there should be substantial synergy between the Institute and the Faculty and the recommendation is that serious discussions of a merger should take place.

Physical sciences, Šiauliai University

Name of the UoA	Physical sciences
Name of institution being assessed	Šiauliai University
Total no. FTE researchers	50,8
Composition of the Unit of Assessment (UoA)	Department of Informatics Methodology; Department of Numerical Analysis; Department of Probability Theory and Statistics; Department of Recognition Processes; Department of Software Engineering; Department of Stochastic Processes; Department of Systems Analysis; Laboratory of Computer Networks

Quality of the research performance and Impact on the scientific research discipline of the UoA	2
The economic and social impact of the research in Lithuania	1
The physical infrastructure of the UoA	3
Research management (including career development and human resource management) of the UoA	2
The development potential of UoA	1
OVERALL SCORE	2



OVERALL SCORE

Although there is a couple of good, but small, research groups the overall score is let down by the overall performance in research. Also there is a very small number of PhD students.

Quality of the research performance and Impact on the scientific research discipline of the UoA

In the Unit the research is divided into three main sections: pure mathematics, applied mathematics with applications in physical sciences and computer science (informatics). There are also experimental studies in spectroscopy and X-ray radiation. The Unit is small, only 3 professors, and has a heavy load in teaching.

The pure mathematics group concentrates on analytic number theory. This is an old field but the team has done its main work in the modern area, the universality property of certain analytic functions, most notable the Riemann zeta function. This work has been well noted internationally and the papers with reviews can be found in the MathSciNet. As in almost every Unit mainly working in mathematics the H index of the Unit shows low figures and one relatively small is not able to the figures up. The work in the analytic number theory deserves the score 3 but considering the scientific output as a whole the score is 1 – 2.

The study directions of the Unit are diverse but the probability theory and statistical methods form a connecting factor. This applies to the pure mathematics as well. Since the stochastic methods nowadays form an important part of pure and applied mathematical analysis this is an encouraging feature for future studies.

The applied field has mainly concentrated in creating mathematical models, based on differential equations, for accurately modeling physical phenomena. These have not found so good international recognition as the aforementioned studies but the studies could be useful on the national level, for example the optimization of the power plant system.

Computer science section has studied e-learning. This is an area with great expectations which have not yet been realized. In spite of this every university should have researchers who can follow the development and make initiatives in this area.

The economic and social impact of the research in Lithuania

The statistics show only one doctoral thesis in the period 1999-2013 but there is a fair number of lower degrees. The studies of analytic functions require a lifelong concentration and are only for few. The studies in the applications of mathematics to physical sciences and economics could be useful for the industrial and economic development of Lithuania. The e-learning also represents a similar possibility in the future.

The stochastic methods in technology and their applications have proved their success in many up to date research areas. The Unit has a good potential here.

The physical infrastructure of the UoA

The studies in pure mathematics do not require an expensive infrastructure. Instead the connections to outside world are inevitable since there are no such mathematical studies in pure mathematics which can be called national. Connections to the leading research centers and universities are now easier than before but experience has shown that face to face communication is important. Hence an infrastructure is needed which provides opportunities to young and senior researchers to visit stimulating research Units. This is very important for young researchers so that they can create lifelong connections. At present longer visits are rare. The Unit seems to lack this type of funding and, compared to other Units, the funding in general is on a very low level.

At present the role of the university library is overestimated in science. The research articles can be obtained using other methods. The university should allocate funds to cover article charges in the future. The computer facilities of the Unit are not up to date and there are equipment shortages in the physics laboratory.

In the fundamental research it is important to be able to invite foreign researchers for a visit of 2-3 months duration and to organize workshops and conferences on the topics of the Unit. It seems that these opportunities have not been realized.

The Unit's research environment is still trying to get to the level which is common in the European universities. In spite of this it is possible to do good mathematical research on a high international level. Since the success is very much based on the individuals, the future is very uncertain.

Research management (including career development and human resource management) of the UoA

The research management seems to be well aware of the situation. The Unit is small and hence very dependent of its top researchers. In general, it seems difficult to keep the top scientists attached to the Unit since in the most cases the other Units are able to offer better working conditions. It is not realistic to try to create a new research area without having a person who is already committed to work at the Institution.

There should be better support from the University for researchers trying to get funding and partnerships from outside.

The development potential of the UoA

In the analytic number theory the Unit has achieved the critical mass since this kind of work is usually performed in rather small groups. However, there are other Units in Lithuania where number theory is studied and this reduces the Unit's future potential. In mathematics and its applications it is important to find new areas, usually close to the expertise of the group, where new research can be made. There are younger and enthusiastic researchers in the Unit but they have not yet proved their abilities on the international level.

Outside the aforementioned group the other research groups are smaller and their potential very much depends how the scientists are able to achieve international recognition. In the areas requiring equipment and extensive infrastructure the possibilities to get enough financial support from the University seem to be weak. Hence the selection of the new research directions must be carefully made and it is no use to start a new research area if there is nobody who has already proved his abilities and committed to continue his work. It seems that the University has given support for undergraduate education but not concentrated so much to create internationally recognized research groups. Success in undergraduate education is more easily recognized than in research. There is also the tendency that successful researchers move to other universities so that the investment to a person could be wasted from the point of view of the University. At least the University should have funds which could be awarded to competent researchers to help them to concentrate on their investigations. International collaboration should also be awarded. At present it was difficult to see any signs of this type of research policy although the Unit supported these ideas.

The Unit should have resources to support 2 – 3 doctoral students. At present their number is too low and without the inflow of young researchers the renewal of the research is too slow. The University did not have a workable plan to tackle this problem although the Unit was well aware of the situation.

The analytic number theory group and the stochastic modeling teams have a common background in using the probabilistic and statistical methods. This seems to be an important asset of the Unit from the research potential point of view.

Conclusions and recommendations

The Unit concentrates on teaching and the Panel found the teaching well organized with well-focused staff but the organization too complicated for research purposes. Since the research groups are small and cover a relatively narrow area of physical sciences, it would be simpler to divide the Unit according to its main teaching directions using the international practice: Mathematics, Physics, Chemistry, Informatics etc...

In analytic number theory the Unit has a good small group of researchers. Stochastic methods form a connecting factor between the research groups. A good sign is that the e-learning group is focusing to the science teaching. There are very few PhD students – the PhD students tend to go to the bigger Lithuanian universities.

The Unit has made an excellent use of the rather cramped facilities. The new University Library is well equipped. The research is on the theoretical side mainly due to the lack of modern laboratories. Co-operation both in research and in teaching with other Lithuanian Units could be better exploited.

Since the theoretical studies require international contacts to the centers where similar research is done, the Panel suggests that the Unit should actively look for possibilities to organize sabbatical leaves for its most active researchers and make it possible for promising young students to visit at conferences. This would also help the Unit to get international research contracts. The Unit seems to offer good possibilities for international students aiming for the Master's degree but this requires that at least some of the courses are taught in English. On the long run this would help to obtain foreign PhD students.

Summary of the Institutional Assessments

General overview and recommendations for Physical sciences in Lithuania:

There is a wide range of research quality across the 19 Units assessed by the Panel. Although none were assessed at the grade 5 level of outstanding and indicating a global leader the Panel found areas of research activity which had this potential, for example, the Optoelectronics and Laser technologies at the Center for Physical Sciences and Technology. At the other end of the grading scale the Panel did not assessed any Units at Grade 1 level which would indicate a poor national player. The majority of the Units were assessed at the grade 3 level indicating a strong national player with some international recognition and the Panel believe that concentrated efforts will be needed to move those Units to the next level. The Panel have made recommendations in the individual Unit assessments.

The Panel found in their visits and assessments a number of Units which they thought could enter into discussions about greater collaboration and cooperation or indeed a merger of their activities. The rationale being that greater synergy and international presence could be obtained. The particular Units were:

- The Faculty of Mathematics and Informatics (Vilnius University) and the Institute of Mathematics and Informatics (Vilnius University),
- The Institute of Geology and Geography (Nature Research Center) and the Geo Faculty of Natural Sciences (Vilnius University),
- The Institute of Biotechnology (Vilnius University) and Institute of Biochemistry (Vilnius University)
- The Faculty of Chemistry (Vilnius University) and the Institute of Chemistry (Center for Physical Sciences and Technology).

For example, in Lithuania there is no major Informatics Unit – Informatics is coupled with Mathematics - providing a clear focus for research and development activities such as technology transfer, interdisciplinary research, benefits to society etc. as is apparent in other countries. As a result there is a concern that Lithuania could miss out on the benefits of a knowledge based economy.

In general the research environment and infrastructure in Lithuania are in good condition having benefited from European funding and the Government initiative to create the Valleys. The Panel found that too often the maintenance and support of the infrastructure was not on a firm basis in that technical and administrative support was provided for using temporary staff.

The Panel found many cases were the research management could be improved and that a clear strategy and objectives were needed. Many departmental structures seems to have developed in an apparently random fashion with no overall policy in place or as the result of historical developments. It is important that modern research management methodologies are put in place and, in addition, early career development policies and promotion criteria are clearly documented.

One of the very pleasing aspects of the assessments was the enthusiasm and commitment of the PhD students; this augers well for the future of research in the Physical Sciences in Lithuania. However as mentioned elsewhere the value of scholarships and in some cases the research facilities needs to be improved. The Postdoctoral level needs to be expanded with more mobility to Lithuania and from Lithuania. These categories of researchers are critical to the future of this area of research.

In summary,

- there is a good student PhD base which needs to be expanded which subsequently could consolidate the future of Lithuania in international research,

- there is a substantial base of modern equipment in the country to facilitate international research but there is a need to ensure continual maintenance and support,
- there are many instances of international research being performed however there are many cases where this research is not being exploited and promoted internationally.

An overview of the research performance across the Panel coverage

Mathematics

The main research areas of mathematics in the Lithuanian universities are number theory, general algebra, discrete analysis, probability, stochastic processes, mathematical statistics, analysis (mainly partial differential equations), mathematical logic (complexity problems), applied analysis and optimization. The connecting factor is probability theory and stochastic methods which are used e.g. in the number theoretic studies. Since stochastic methods are now much used in analysis, the knowledge in this area will most likely come into use in the future. In general the emphasis is very much on basic research.

Many areas of mathematics are missing but this is not a drawback since the research must be concentrated in the areas where the critical mass can be achieved. Mathematical research is usually done in small groups, and Lithuania is no exception, but the research groups must not be totally separate. They should be able to support each other's research and, more importantly, be able to produce new groups to work on interesting problem areas. Hence the universities with a department for mathematics and a separate institute for similar research seem to be over organized and more flexibility would be achieved in a single Unit. This will also help the Units to find their own profile in mathematical research. There is no need to divide the Units into small sections since these prevent new research groups to gaining recognition.

The number of PhD's is on a good level in Lithuania since in mathematics this number is usually lower than in other sciences. The main emphasis must be set on the quality of the PhD students. This will open the doors for Postdoctoral exchanges. International research contracts at present are on a rather low level (in general, there are not many available for basic mathematical research) but through better personal contacts the possibilities for longer visits of Lithuanian young researchers should improve. International co-operation should be rewarded (in some countries credit is given for papers with foreign co-authors),

It is very difficult to create spin-off companies in mathematics but good PhDs in mathematics are needed in many areas including industry. There should be a method to give credit for those Units who have educated successful PhD's.

Altogether there are 2 – 3 groups who have been able to achieve excellent internationally recognized results in mathematics. The highlight is the group working on the Navier-Stokes equations. Also the research in number theory is on a good level in several universities including the work of the universality of the Riemann zeta function. On the more applied side there is a number of good projects like the long pipe modelling program.

Computer oriented education in science is studied in almost all universities. In this area the Units should find an independent profile. This is the only way to gain international recognition.

Informatics

There are two Units which have Informatics combined with Mathematics and in only one of these Units is Informatics the main subject.

Given the developments internationally this is a major omission in the Lithuania's research portfolio in not having a strong well focussed, highly active Informatics Unit in the country. Computing technology is now a dominate contributor to most economies and to society as well as contributing strongly to research in other subjects, for example, the use of image processing, computational science etc. Lithuania appears to be missing out on such developments and needs to take urgent action in its universities to focus Informatics

research and development and thereby capitalise on the benefits that can be reaped in research, industry and commerce and society.

There are the foundations for such a development as there is already some research activity at the international level, activity in technology transfer, a good base of PhD students and some computational resources at the European level. However the overall activity is diverse and needs to be coordinated and better managed plus provide with an external stimulus or initiative to create at least one a major internationally active Informatics Unit in Lithuania.

Physics

Physics in Lithuania is on a very positive slope. The strong fields of Lithuania are optics and lasers, nanotechnology and semiconductors. Among the 5 Units with a grade of 4 (strong international player), 4 are dealing with Physics. However, one has to be careful because if you do material sciences, it is often a mixture of Physics and Chemistry. All the other Units, involved with Physics, have a grade of 3 with the exception of Material Science (FTMC_MM), penalized by the lack of efforts in recruiting PhD students, the inhomogeneities of the Departments or Groups; some doing very well and some not very active but that could be corrected quickly. Some of the Units are made of 4 or 5 Departments and it is not obvious to see the links between them; it is the role of the management to correct that and to refocus the fields if necessary.

During the visits to the laboratories, we have been impressed by the remodelling of many buildings, the construction of the new valley (Saulėtekis) and the installation, during the last few years, of very modern equipment. This should allow an increase in the scientific production.

There seems to be a strong emphasis to do applied research and we can understand that this is important for Lithuania but one should keep a good balance between basic and applied research: most of the important applications, in the last 70 years, have come from basic science. It is also fundamental to keep or develop good theory groups.

Chemistry

The quality of chemistry research is generally good at the national level with a good number of internationally competitive researchers at several institutions. Some of the present “mid-level” academics have the potential to become international leaders and already are a credit to the Lithuanian Nation. Like other areas chemistry research suffers from management issues, partially unfavourable age distribution and lower morale of older staff, and low numbers of post-doctoral fellows and graduate students.

The analytical instrument base required for chemical research is present and in an excellent shape. Likewise, teaching facilities are general good. Minor future problems might arise from some of the strategic plans of smaller units. There is too much future focus on electrochemical research (however, this is excellent for industry-related cooperation), and interest to go into biotechnology research (would create overlap with biochemistry units and be a dilution of efforts). On the other hand a good foundation in “sustainable chemistry” could be strengthened and become a national focus in chemistry. International cooperations are generally good and offer a good basis for the future. Younger staff is mobile and engaged and should be involved more in the management of the units.

Biochemistry

Biochemical research has a long and proud tradition in Lithuania. As a result significant applied research output has been generated in past years and there is a strong track record in translational research. This is accompanied by several internationally recognized groups (e.g. in enzymes, screening and proteomics and bioelectrochemistry) with a good number of promising younger academics in the pipeline. The main strength of this area lies in the excellent calibre of the Ph.D. students (probably the best in all the sciences in Lithuania). Coupled with excellent instrumentation and good prospects for the superior infrastructure and

this area offers significant potential for the future. However, this will require significant restructuring to generate critical mass, to weed out unsustainable and outmoded subunits (e.g. the more chemically related ones, this can be delivered by a new and stronger chemistry unit at VU) and especially in motivation and management of the staff. Innovative teaching methods need to be developed to train and motive students and staff and to make full use of the translational potential. International contacts are generally very good, students and younger staff are mobile and have vision. Problems exist in some units with regard to a significant percentage of unmotivated staff and, sometimes (for VU_BTI) lack integration into the home institution. Next to a physical merger of the larger units the main future task will have to focus on better accountability to the Lithuanian taxpayer in terms of return for money as the present output falls short of expectations.

Geology

There are no Units in Lithuania based on Geology alone. The two Units evaluated contained geography, hydrology and climate research components and in case of the Vilnius University also hydrogeology and engineering geology, the latter being quite engineering subject. The geology and the physical geography components within the Units cannot be separately evaluated on the base of presented materials. Geological disciplines and also hydrogeology and engineering geology are taught only at the Vilnius University in Lithuania. Based on that fact, it would be extremely important that both, the teaching and the science components must be at a good international level, in order to support Lithuanian society requirements. At present, geological research has been conducted at Vilnius University (Department of geology and mineralogy and Department of hydrogeology and engineering geology) and in the Institute of Geology and geography, Nature Center (Laboratory of Bedrock Geology, Laboratory of Geo-environmental Research, Laboratory of Nuclear Geophysics and Radioecology, Laboratory of Quaternary Research).

However the overall activity of the Units is somewhat diverse and needs to be coordinated and better managed (the Faculty management at the Vilnius University showed extremely low quality). There is lack of critical mass within sub-units. It seems that at the moment, an external stimulus or clear initiative to enhance the quality in geological sciences is missing in Lithuania. None of the Units is well equipped to proceed with international quality research; neither have the proper age distribution to support sustainable development of both Units separately. It is highly important for the country to proceed with better defining geological sciences, for instance into a single strong Unit. This may involve merging the geological research groups of the two Units, by that way diminishing duplication of research topics and better using limited human resources (cutting down the number of “double positions”). At the same time renovation of instrumentation and equipment is urgently needed, especially in the fields of analysing rock, water and soils geochemical composition. The latter is also important in pursuing environmental research.

Physical geography

There are no Units in Lithuania based on Physical Geography alone, so the geology and the physical geography components within the Units cannot be evaluated separately on the base of presented materials and visits. In a broad sense, the Department of geography and land management, the Department of hydrology and climatology, and the Centre for cartography, from the Vilnius University Unit and the Laboratory of Climate and Water Research, partly the Laboratory of Geoenvironmental Research, and partly the Laboratory of Quaternary Research do work in the field of Physical Geography. So, following this structure, the geographical sciences are even more fragmented in Lithuania than geological sciences. There is duplication on research and also in using human resources. None of these sub-units have high international visibility, all sub-units are small in terms of financing and number of PhDs and researchers/professors and most likely are not sustainable in the near future. However, most of the research topics are important for the country and cannot thus simply shut down. Instead, a better coordination and management is vital to ensure sustainability and internationally visible research output. Lack of critical mass in sub-units, insufficient

equipment and distinctive research fragmentation requests immediate organizational changes. Merging the above-mentioned Units is one of the most straightforward receipts to overcome mentioned difficulties.

A final comment about geology and physical geography

Both fields are strategically important for development of Lithuania. Moreover, as geological and physical geographical sciences share extensively the research objects, the research methodology and equipment, one should raise a discussion about the possibility of re-organising both geology and geography into a single (joint) Unit. This Unit can be entitled Earth Sciences. For satisfying the public, practical and scientific needs and as a future development pre-requisite, the Unit needs nation-wide strategic development plan.

Astronomy

Astronomy research is connected closely to physics, being one of the three focus areas in the Institute of Theoretical Physics and Astronomy at Vilnius University (VU-TFAI). This Unit also operates the Astronomical Observatory as well as the Planetarium. In addition, some related theoretical research is carried out in the Material Science Institute of Center for Physical Sciences and Technology (FTMC-MM). The research is at the top Baltic level, but with more ambitious goals could better compete internationally, at least in the European scale within the selected research topics.