TAMPERE UNIVERSITY OF TECHNOLOGY

Tampere University of Technology Research Assessment Exercise 2017

Contents

Foreword

TUT encourages the pursuit of excellence in research and actively seeks to identify and strengthen promising areas and new lines of research. To help us succeed in our efforts, we wanted to conduct a forward-looking Research Exercise Assessment that focuses on research and not on organizational issues. In this assessment, we used a bottom-up approach, where researchers themselves defined their units. In order to ensure better consistency in the evaluations, we had a single multidisciplinary peer review panel. In addition, apart from existing research communities with on-going collaboration, we also welcomed researchers to propose new openings, i.e., new research communities working on novel state-of-the-art ideas. Finally, in anticipation of the new university being created in Tampere by merging TUT and the University of Tampere, we invited research communities to include researchers from the University of Tampere to see existing and potential links between researchers in these two universities.

The process of the Research Assessment Exercise provided the university with a profound analysis of the contents and quality of research conducted at the level of research groups. TUT RAE 2017 gave us insights on research activities taking place independent of organizational structures. The assessment enables us to better plan for the future in terms of allocating resources for both research infrastructure and research staff in the most effective way to support research that has the highest potential. The process gave research communities a chance to plan their research activities in a wider context and receive feedback from an expert panel on the feasibility of research plans from the viewpoint of international competition. In a nutshell, the extent and quality of research conducted at TUT became more visible to the Board of TUT Foundation and executive officers.

We set out to evaluate the potential of our research, and this is exactly what we received; the international expert panel provided inspiring insights on the contents and quality of our research. The panel was in general impressed by the level of the research as well as our research infrastructure. The panel faced a challenging task in evaluating heterogeneous research communities, but was nevertheless able to pinpoint our top communities. We also received ideas on how to better exploit our current strengths to enhance the research activities of the entire university. All communities received useful feedback and the discussions during the site visit week were extremely rewarding. We are very grateful to the panel members for giving their time and dedication in helping us. TUT RAE 2017 provided invaluable information for supporting our research communities to improve their activities further.

Prof. Ulla Ruotsalainen, Vice President (2015-16)
Prof. Jarmo Takala, Vice President (2017-18)

Introduction

Methodology

TUT RAE 2017 was a voluntary and selective exercise, and there were two assessment categories:

1. *Existing Research Communities* (= established RCs that have co-authored publications and conducted joint projects)
2. *New Openings* (= new RCs with a new research opening in regards to the state of the art in the field)

Taking part in the assessment was voluntary and researchers formed the units of assessment themselves. A TUT RAE 2017 unit of assessment is a Research Community (RC) that is independent of organizational structures. In anticipation of the new university, the RCs were invited to also include researchers from University of Tampere. There was an internal review of the RCs in the beginning of 2016 where the RCs applied to be accepted as units of assessment in TUT RAE 2017 in either one of the categories explained above. The applications were assessed by an internal panel comprising the Deans, the members of the Science Council and a representative from the University of Tampere. The internal panel selected the best and the most potential RCs to be assessed by the international evaluation panel in TUT RAE 2017. Altogether 30 RCs applied and 20 were accepted as units of assessment of which 15 belong to the category of Existing Research Communities and the remaining 5 to the category of New Openings.

TUT RAE 2017 was an evaluation of research activities, of the people who conduct the research and, most importantly, of the potential found in both the activities and people.

Objectives

The Research Assessment Exercise was geared firmly towards the future. TUT seeks excellence, including potential excellence and wanted to find out if the RCs are sufficiently ambitious in their research questions and methodological approaches and if the scientific output of the RCs is significant, compared to the best units in the world. TUT welcomed all recommendations on how to improve the overall quality of research conducted in the university.

More specifically, TUT conducted the Research Assessment Exercise in order to:

- identify those RCs that have the potential to be among the best in the world
- get recommendations from the panel on how to transform good RCs into excellent RCs
- find out if the RCs are dealing with new pertinent and high impact research questions in their fields
- get the panel's feedback on how to support potential and sustain existing excellence

Utilization

In TUT's first Research Assessment Exercise in 2011, one of the objectives was to get up-to-date knowledge on the quality of research conducted in the university. The aim of TUT RAE 2017 is to improve the quality of research. TUT will use the results of the Assessment as basis for allocating resources to the most promising RCs. The results will also contribute to the development of the research strategy of Tampere3.

Schedule

Conducting the second research assessment exercise in 2017 was decided by the Board of the TUT Foundation already in 2011, after the first assessment. The Academic Board of TUT decided on the methodology for the assessment in May 2015. The call for internal review closed in February 2016 and the units of assessment were decided in May 2016. The Terms of Reference –document defining the methodology, aims and utilization of the assessment was finalized in June 2016. Collecting the data for the assessment material, for example, for the bibliometric analyses, took half a year in total, from October 2016 until February 2017.
The international assessment panel consisting of 10 experts was confirmed in December 2016. The assessment material was made available for the assessment panel in May 2017 and the site visit week took place in June 2017.

Organization of the assessment

International expert panel:
Chair
Professor Ulrike Beisiegel, President of the Georg-August-Universität Göttingen, Germany

Panel members
Professor Erik Aurell, KTH Royal Institute of Technology, Sweden
Professor Thomas Baer, Stanford University, USA
Professor Ibrahim Dincer, University of Ontario Institute of Technology, Canada
Professor Tore Haugen, NTNU, Norway
Professor Jos van Hillegersberg, University of Twente, Netherlands
Dr Benny Lo, Imperial College London, UK
Professor Matteo Santin, University of Brighton, UK
Professor Julia Stegemann, University College London, UK
Professor Sergios Theodoridis, University of Athens, Greece

The assessment process was managed by a **Steering Group**:
Professor Heli Jantunen, University of Oulu, Chair
Professor Pertti Haapala, University of Tampere
Professor Sirpa Jalkanen, University of Turku
Vice-President Ulla Ruotsalainen (until 31 Dec 2016)
Vice-President Jarmo Takala (as of 1 Jan 2017)

A **Working Group** supported the planning of the Assessment:
Vice-President Ulla Ruotsalainen, Chair (until 31 Dec 2016)
Vice-President Jarmo Takala, Chair (as of 1 Jan 2017)
Academy Professor Moncef Gabbouj
Professor Mikko Kaasalainen
Professor Juho Kanniainen
Professor Martti Kauranen
Professor Minna Kellomäki
Senior Res. Fellow Matti Linjama
Research development manager Anu Juslin

An **Internal review panel** selected the 20 Research Communities to be assessed:

Vice-President Ulla Ruotsalainen, Chair
TUT Management group:
Professor Martti Kauranen
Professor Petri Suomala (vice dean Professor Pauli Kolisoja)
Professor Jarmo Takala
Professor Jyrki Vuorinen
University of Tampere:
Professor Pertti Haapala
TUT Science Council:
Academy Professor Moncef Gabbouj
Professor Mikko Kaasalainen
Professor Juho Kanniainen
Professor Martti Kauranen (personal deputy member Professor Esa Räsänen)
Professor Minna Kellomäki
Senior Res. Fellow Matti Linjama

Secretarys: Anu Juslin, Laura Himanen

Project manager:
Research specialist Laura Himanen

Assessment material

The international expert panel based their assessment on the material that was provided for the panel members prior to the site visit week and on the interviews and discussions that took place during the site visit week in Tampere.

The assessment material consisted of:

- the RCs' research plans for the years 2017-21
- details concerning the members of the RCs
- details concerning the funding of the RCs
- details concerning the research output of the researchers in the RCs
- bibliometric analyses based on the Thomson Reuters Web of Knowledge and Elsevier's Scopus databases
- background information about TUT and the Finnish higher education and research system

The time period for the background material concerning the RCs (information on research output, research funding, doctoral degrees, members of RC) was 2012-2016. The bibliometric analyses cover the years 2011-15 (citations also the year 2016). The assessment materials only included the research performance of those members of RCs who were employed by TUT or UTA on the Census date, 1 October 2016.

Bibliometric analyses

The bibliometric study uses multiple indicators and two different datasets in order to better describe the complex patterns of publications at a technical university.

Several impact measures are used. Firstly, citations are considered as a direct measure of impact. Secondly, collaboration analyses and collaboration network analyses were conducted. Collaboration is measured through co-authorships. We provide visualizations on collaborative networks based on Scopus datasets. Scientific networks do not follow organizational boundaries, but spread internationally across thematic and cross-disciplinary areas. Communication with peers is one form of interaction that can provide intellectual exchange, which is required for the development of new ideas. Lastly, an overall visualization of research themes was conducted by creating keyword co-occurrence analyses. This theme analysis aims at describing how the ideas have been published and it provides understanding on the content and topics of the research in the Research Communities as well as an overview on how the research themes of the RCs have evolved during the year range included.

Approach

The analysis was conducted in two phases. Firstly, bibliometric analyses based on Web of Science data were conducted by the Leiden University Centre for Science and Technology Studies (CWTS) for all Research Communities that had more than 40 publications during the years 2011-15. Secondly, TUT Library analyzed Scopus data. Both data sets were collected by TUT Library Bibliometric team.

Two separate databases were used to collect the data. Web of Science (WoS) data consists mostly of bibliographic data on scholarly journals, and is considered to be of high quality and

is the gold standard database for bibliometric studies. However, in fields that publish a great share in conference proceedings, the coverage may be low. Therefore, TUT Library collected an additional dataset from Scopus to be able to show impact based on the publications that are not present in WoS data. In the reports we show the results from both datasets if the threshold of 40 publications required for WoS-based analyses was met. This was the case for 17 research communities. For the remaining three, only Scopus-based analyses are presented. Both datasets cover the years 2011-2015.

Table 1. shows the included document types. For all analysis, a full counting method was used, and self-citations are excluded. Full counting means, that the publications are not divided by the number of authors, but counted as one.

Table 1. Document types of publications included in the datasets

Web of Science	Scopus
Article	Article
Review	Review
Letter*	Conference paper
	Book chapter
	Book
	Short survey
	Letter

**NOTE:*In WoS analysis, type Letter was weighted as 0.25 because they make smaller contribution, and therefore would distort the analysis.

For Scopus dataset, collaboration and keyword co-occurrence analyses were conducted with VosViewer analysis tool (version 1.6.5; http://www.vosviewer.com/). When looking at the visualizations, however, it should be kept in mind that the network analysis are more of an overview and a generalization than an exact bibliometric analysis. Therefore, the results should be considered carefully.

Collaboration maps display collaborative relationships between organizations. An organization name thesaurus was created in order to disambiguate the organization names. We used full counting in our analyses. Especially in analyses based on small data sets, it is unlikely that results obtained using full and fractional counting will be very different. The collaboration maps show the actors in a scientific collaboration network and how different actors group together in different areas within network. Also, the impact of the co-authored output is shown in the analysis.

Co-occurrence of author keywords are displaying the research themes of the research communities. Two different co-occurrence maps were created, one indicating impact and the other indicating the average year of output in each cluster. Largest network was selected for the display. We used full counting in our analyses.

In the research communities, there were researchers from TUT, UTA and external organizations. Research output from TUT and UTA were treated the same way (i.e. all publications from the year range 2011-2015) but the output from external organizations were considered relevant only if the publications were co-authored with a TUT affiliated researcher.

If the same person appeared in two or more groups, the researcher was asked to divide her/his publications to the communities in such way, that one publication is assigned to one research community only.

Indicators for Web of Science data

Table 2 shows the basic indicators of the scientific impact for WoS data. Table 3 shows the field and size independent indicators of scientific impact. All indicators in Table 3 are normalized for differences in citation practices between scientific fields. For citation-based indicators, citations are counted until 2016. Author self-citations are excluded.

Table 2. Basic Web of Science indicators

Indicator	**Description**
Internal coverage	Indicates the relevance of bibliometric analyses. The internal coverage of a set of publications in WoS is measured by the percentage of references from the output analyzed that are also covered by WoS.
P	Number of publications in international journals of the unit of analysis in the period
TCS	Number of citations received by P during the entire period, excluding self-citations
MCS	The average number of citations without self-citations per paper

Table 3. Normalized Web of Science indicators

Indicator	**Description**
MNCS	The mean field normalized citation score in the traditional way; the actual number of citations is divided by the expected number of citations, per paper. Here, the expected number of citations is based on the world-wide average citation score without self-citations of all similar papers belonging to the same field (i.e. publication-level field). In this way, a field normalized score is calculated for each paper. Next, the MNCS indicator is computed for each unit of analysis, by taking the average of these field normalized citation scores for individual papers. A value above 1 indicates that the mean impact for the unit is above world average whereas a value below 1 indicates the opposite.
MNJS	The mean normalized journal score indicates the average citation impact of the journals in which the papers appeared that were published by the unit of analysis. The indicator is calculated based on the same principles as the MNCS. It shows whether the publications were published in top or in sub-top (in terms of citation impact) journals.
PP(top10%)	The percentage of highly cited publications. The percentage of publications published by the unit that are among the upper top 10% percentile of the citation distribution for similar papers belonging to the same fields.
PP(uncited)	Percentage of publications not cited by others (in the given time period)
Proportion of self-citations	The share of citations that come from papers with at least one author that is also an author in the cited publication.
PP(collab)	Proportion of collaborated papers.
PP(int collab)	Proportion of internationally collaborated papers.

Indicators for Scopus data

Table 4 shows the indicators used in Scopus analysis. All citation measures exclude the authors' self-citations. Citations in Scopus were considered at the end of February 2017. The Scopus indicators are not normalized.

Table 4. Scopus indicators

Indicator	**Description**
Internal coverage	Indicates the relevance of bibliometric analyses. The internal coverage of a set of publications in Scopus is measured by the percentage of references from the output analyzed that are also covered by Scopus.
P	Number of publications
H-index	H-index indicates the number of documents of the RC n that have been cited at least n times.
TCS	Total citation score is the number of citations received by the output of RC (without self-citations of authors).
MCS	Mean citation score is the **TCS** divided by the total number of output (**P**) of the RC.
N-uncited	Number of uncited publications in Scopus
PP(uncited)	Percentage of uncited publications in Scopus
Proportion of self-citations	The share of citations that come from papers with at least one author that is also an author in the cited publication.

ASSESSMENT REPORTS – NEW OPENINGS

Category of New Openings = new RCs with a new research opening in regards to the state of the art in the field. The RCs assessed in the category of New Openings are not necessarily established research communities with a history of joint projects or co-authored publications. The RCs assessed in the category of New Openings were not required to meet the threshold of 40 publications necessary for conducting bibliometric analyses based on the Web of Science database.

Research Communities belonging to the category of New Openings:

- Institute of Society and Space (SOCIS)
- Intelligent dexterity for secure networked infrastructure and applications (IDSNIA)
- Mathematical modeling with wide societal impact (MathImpact)
- Multi-scaled biodata analysis and modeling (MultiBAM)
- Regulation of learning and active learning methods (REALMEE)

The assessment criteria in the category of New Openings

Novelty of research: the most important criteria for a RC being accepted as a unit of assessment in the category of New openings was that the research idea of the RC is new in regards to the state of the art in the field internationally. The panel was therefore first asked to assess the novelty and innovativeness of the research as presented in the research plan on a scale from 1 to 5. Where 5 means that the RC is dealing with a totally new research question and 1 means that the RC is dealing with an already well-established research question and cannot be considered as a new opening.

Scientific quality and impact: the potential scientific quality and impact the RC proposes in its research plan, in terms of originality and significance.

Societal relevance of research: the potential reach and significance of the research proposed by the RC in its research plan in terms of the society at large. Will research results be relevant to the needs of many user communities? Are the foreseeable user communities mainly local or global? Do the RC's research questions address globally relevant topics? Will the research proposed by the RC be relevant in the production of new knowledge and solutions for, e.g.: business life, civil society, health and welfare, environment or policy-makers, on the national and/or global scale. Please note that even the highest rating does not necessitate a primarily international relevance.

The consortium and research environment: the intellectual competence of the RC and its environment. Is the RC a credible consortium to fulfil the RC's research plan? Is the combined scientific potential of the RC's members sufficient? Are the members well-suited for conducting the research planned? More specifically, the panel should consider if the RC has sufficient infrastructure, if the personnel structure supports conducting high quality research, if the RC is international in terms of recruiting, networking and collaboration, if the mobility and networking (national and international) are relevant, and if the RC has a sufficient number of PhD-students to ensure continuity in its field.

Suggestions for the future: In this section the panel was asked to consider ways in which the RC could best fulfil its potential. Are there changes needed in the personnel structure or does the RC need additional expertise in a specific area? How can the university best support the RC?

The rating scale

5 – Outstanding
4 – Excellent
3 – Good
2 – Satisfactory
1 – Unsatisfactory

1. Institute of Society and Space (SOCIS)

Head of Research Community: Panu Lehtovuori

Abstract

Urbanization is one of the most important global trends that will profoundly reshape societies both globally and in Finland. As a complex and manifold phenomenon, urbanization calls for strong interdisciplinary research. The new Institute of Society and Space (SOCIS) research community merges the capabilities of two currently separate research communities in Tampere University of Technology (TUT) and University of Tampere (UTA). In this way, several research areas can be brought together, including urban planning, architectural design, sustainable construction, adaptable housing, urban complexity, participatory practices, leadership, innovation, identity, humanitarian migration and environmental policy. SOCIS addresses global issues of urbanization but utilizes Finnish urban transformation as its primary platform or "urban laboratory".

Panel report

1. Novelty of research

Rating: 3

The need for changes caused by the rapid urbanization on a global and national level requires research-based knowledge development for planning, design, construction and life-long management of our built environment. The RC addresses this in a new way based on a multidisciplinary approach, and it represents useful research on a national level which can get relevant on the international level.

2. Scientific quality and impact

Rating: 3

The RC addresses research related to the sustainability challenges that rapid urbanization creates globally, national and locally. The RC brings together scientists from both TUT and UTA, giving a potential for interdisciplinary research and development projects. This brings a number of existing research areas together, giving a possibility for research related to the global urbanization and using the Finnish urban transformation as its "urban laboratory".
The theoretical framework for the research is not very well developed, and there is a very broad approach to the research and the various questions raised related to the rapid urbanization.

The scientific quality and impact are considered to be good, as the research provides useful knowledge and influence in the field. There is a great potential for developing ideas that can give incremental advances in knowledge and methods in the field of regional and urban planning, sustainable technological and spatial transitions.
The research topics arranged along the top-down and bottom-up thematic areas, creates a platform for potential national and international impact from research in this area.
The number and the impact of SOCIS publications and citations are rather low compared to leading international research groups.

3. Societal relevance of research

Rating: 3 to 4

The RC has great societal relevance, especially on a national and regional level. The knowledge developed will be the basis for planning and development of urban areas and the cities for the future.

The research results will be useful for different user communities, and the RC will provide new knowledge and solutions that benefit the society at large. The RCs research questions are globally relevant and useful for business life, civil society, welfare, environment and policy-makers on the national scale.

4. The consortium and research environment

Rating: 3

The SOCIS RC has been formed around two currently separate research groups (at TUT and UTA), and represents a good new opening based on multidisciplinary approaches for solving important challenges associated with urbanization. The presentation of the RC's research plan showed a positive and rapid development of this cooperation and indicated the potential for developing a strong RC.

The RC consists of a credible consortium with highly qualified architects and planners, as well as members with scientific potential, but the coherence of the group could have been more convincing.

5. Suggestions for the future

Recognising that the Smart Cities concept is not the solution to every problem in urbanization, the RC should nevertheless consider the relevance of this concept to their work and open up for possible co-operation.

Increased theoretical model development and more basic research would lead to output of high quality publications.

Bibliometric report

Indicators for Scopus data

Internal coverage of the research community is 37%, which is considered as moderate coverage. This indicates that the majority of the references are outside the coverage. Therefore the bibliometric analyses should be considered very carefully. Also, the output is very small, which indicates that this dataset is not necessarily suitable for bibliometric analysis.

Table 1. Scopus indicators

Indicator	Performance
P	31
H-index	6
TCS	129
MCS	4.2
N-uncited	9
PP(uncited)	29%
Proportion of self-citations	16%

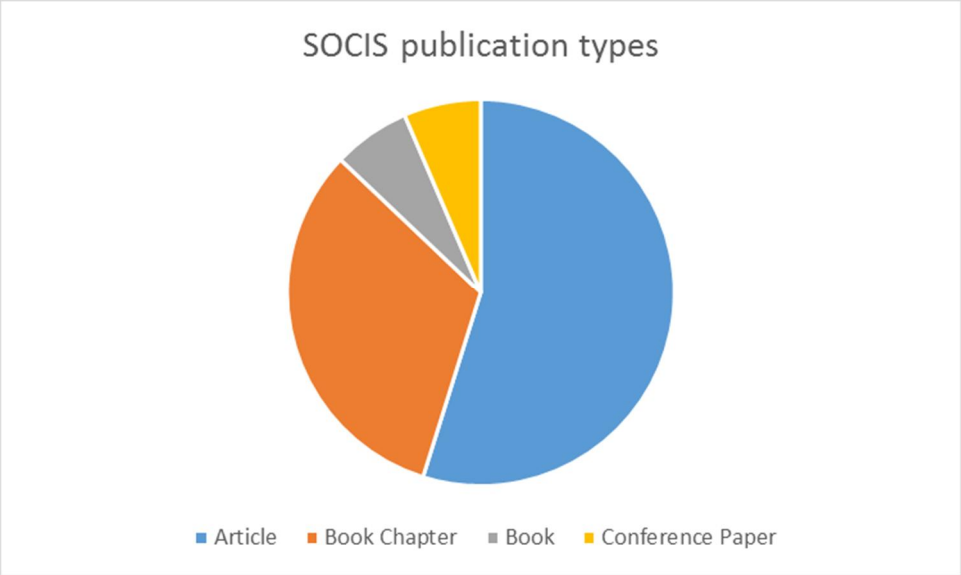


Figure 1. Publication types in Scopus dataset.

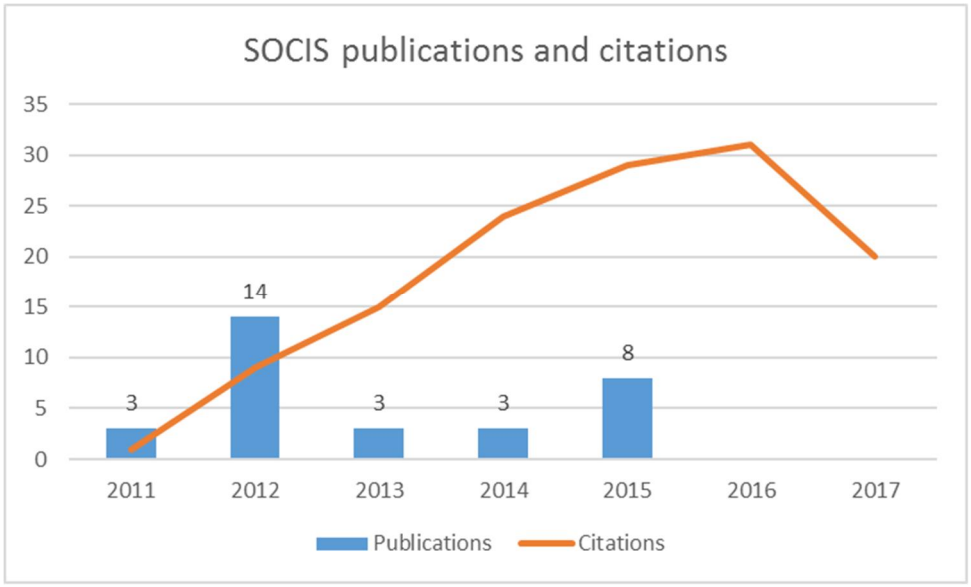


Figure 2. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

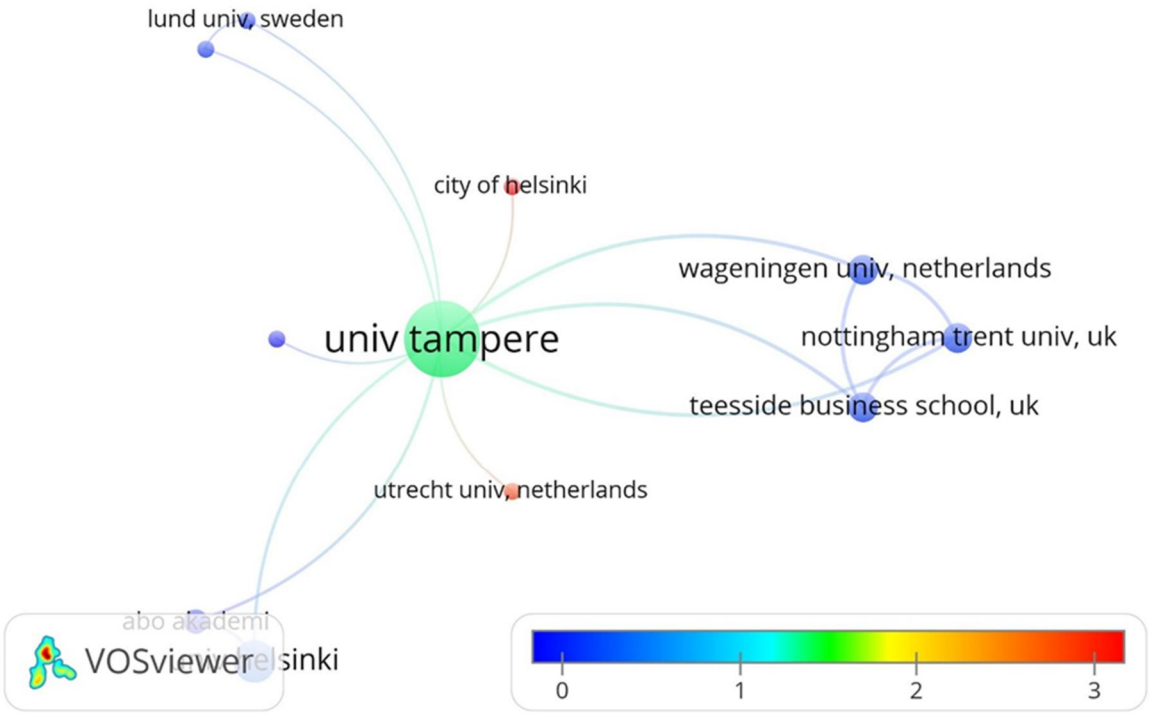


Figure 3. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

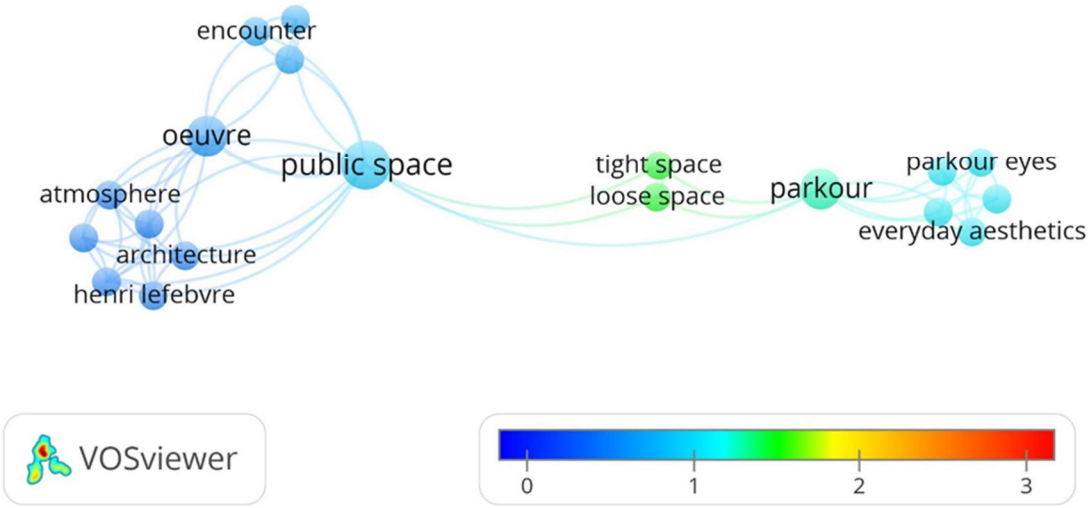


Figure 4. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

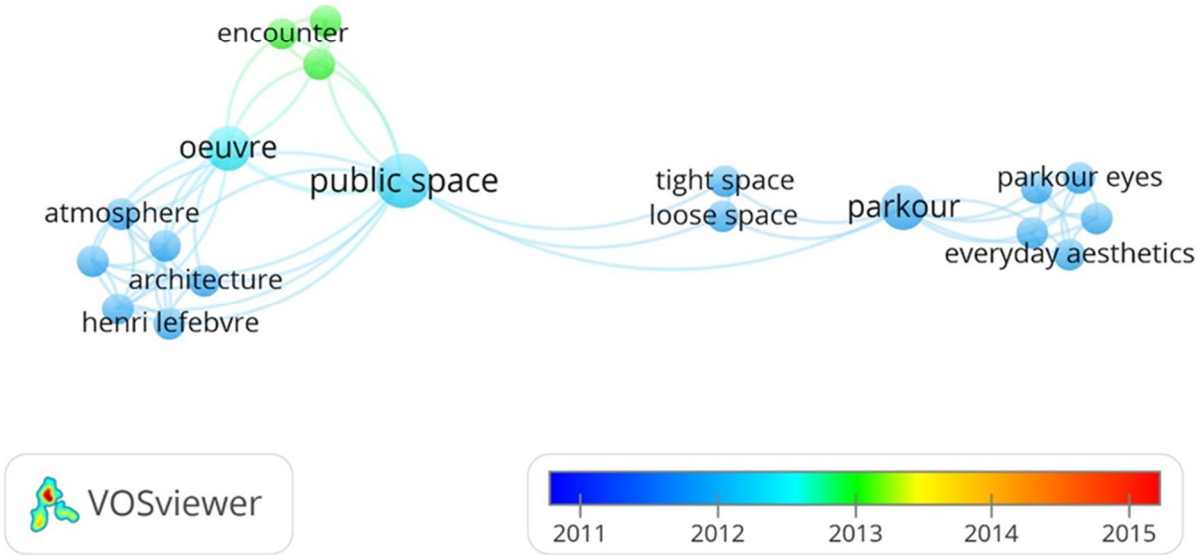


Figure 5. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

2. Intelligent dexterity for secure networked infrastructure and applications (IDSNIA)

Head of Research Community: Kari Systä (Jarmo Harju)

Abstract

The computing and networking infrastructures are becoming more ubiquitous but at the same time more heterogeneous than ever before. Consumers already have several personal devices – a portable computer, a smartphone, a smart TV, a tablet – and, in parallel, the trend of Internet-of-Things leads to a world where physical objects around us become fully interconnected over various wireless technologies. These developments create an unprecedented need for interoperability between all devices and related networked technologies. Furthermore, these developments open possibilities for novel applications and user experiences, where consumers can truly seamlessly utilize all of their devices leading to the best experience, while maintaining continuous and reliable access to the desired resources and services by using networks that best fit the current needs, in a secure, private fashion. The individual research teams behind the proposed RC have conducted successful work on underlying software architectures, networking technologies, and security issues. However, we firmly believe that these separate groups have excellent potential for synergy, where joining forces as an RC opens attractive research opportunities.

Panel report

1. Novelty of research

Rating: 2/3

The research community has a very ambitious goal of tackling the interoperability and system integration challenges in the area of Internet of Things. Although there are many attempts by other research groups, compatibility and interconnectivity issues among devices and systems remain a major research task. This research community aims to address the underlying research challenges in software architecture, networking, and security. Although this community has the potential to generate innovative solutions, it is tackling a rather well established research question.

2. Scientific quality and impact

Rating: 3

This research community consists of very competent academics and researchers, who are established in their own respective fields. This collaborative effort could potentially lead to advances in this relatively new field. This would, in this is a fast-growing field, allow a better scientific impact and the possibility to publish more in top journals and on international conferences. In addition, as the field is also widening, it should focus on a specific area and establish itself to become a world leader in that area

3. Societal relevance of research

Rating: 2/3

As the research mainly focuses on the infrastructure to support interoperability among devices and systems, it could lead to a transformative effect in other fields, applications and user communities. However, it currently lacks the target applications to demonstrate the potential impact of this community. Identifying potential applications could help the community to plan the pathway to impact, nurture new interdisciplinary collaborations and realize the full potential of its research.

4. The consortium and research environment

Rating: 3

The members of this research community are very motivated and share the same vision. Combining the expertise of three different core areas, i.e., software, networking and security, there is a great potential for future excellence. Given the increasing interest in Internet of Things, their work can potentially attract much research funding. The members of the community have already established some international collaborations, but it could be more proactive in establishing a wider network with other research groups nationally and internationally, especially in this rapidly growing field of the Internet of Things.

5. Suggestions for the future

The research community needs to identify one or more potential applications of its research. It will help in setting the directions of its research and realizing the impact of its work. Also, the community needs to publish more in high-impact journals, increase its international visibility by organizing international conferences/workshops/special issues, and influence the standardization of device connectivity by proactively getting involved in standard organizations, such as IEEE Standard committees.

Bibliometric report

Indicators for Scopus data

Internal coverage of the research community is 36%, which is moderate coverage. The majority of the publications in the field are outside the coverage. Therefore the bibliometric analyses should be considered very carefully.

Table 1. Scopus indicators

Indicator	Performance
P	69
H-index	9
TCS	263
MCS	3.1
N-uncited	41
PP(uncited)	59%
Proportion of self-citations	26%

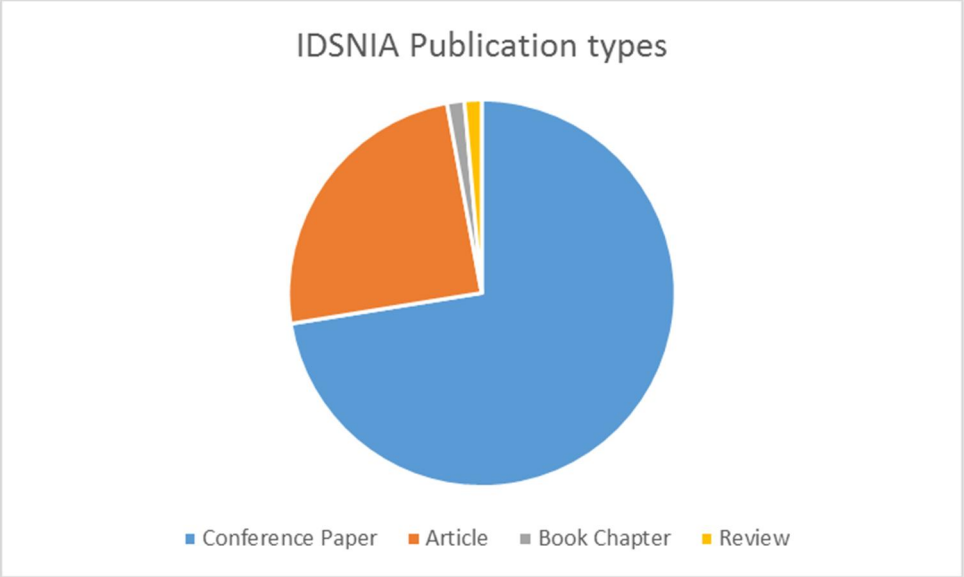


Figure 1. Publication types in Scopus dataset.

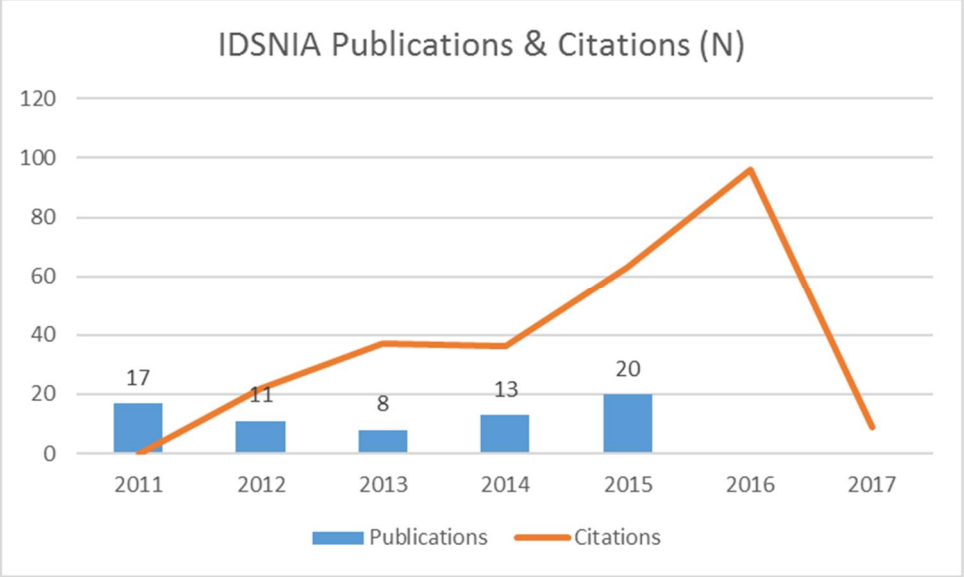


Figure 2. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

3. Mathematical modeling with wide societal impact (MathImpact)

Head of Research Community: Mikko Kaasalainen

Abstract

In this new research opening, we develop common mathematical methods to solve important open problems in forestry, ecology, and computational finance. We create new models, based on extensive data sets, and new ways for the digitalized dissemination of research results. In forest research, we aim to bridge the fundamental gap between theoretical plant models and the real world, which will have considerable impact on tree growth predictions, forestry, and ecological modelling especially under the climate change. Our ultimate goal is to enable the construction, viewing, and computational use of a detailed, quantitatively correct functional model of the entire global biosphere. In financial engineering, we obtain key social information from financial data, and model how the effects of personal profiles (e.g., panic thresholds) spread in the markets. We introduce live net-based papers in open access and use game-based interactive dynamic approaches for efficient dissemination of the models to a wide variety of audiences. We believe that one must be able to play with a model to understand it properly. This opening supports the strategic TUT areas of digital operating environment, energy- and eco-efficiency, and light-based technologies.

Panel Report

1. Novelty of research

Rating: 3

The RC claims novelty is in the application of combining bottom up mechanistic approaches with top down generalization to forestry research and financial systems. The panel considered that the novelty is more in the application area than in the proposed methodology.

2. Scientific quality and impact

Rating: 3

The group uses very good mathematical modeling practices including stochastic modeling, complex systems and agent based modeling. Models are tuned and evaluated using real world data which is an excellent approach, not unique but often lacking in similar studies. The scientific impact is good, especially in the tree/forest modeling area that has a long tradition and is externally recognized.

The two application domains are well chosen, but the underlying research challenges and wider application area of the models is not clearly defined.
The combination of mathematical and complex systems modeling combined with game based learning and gamification is very promising. However, it needs more elaboration in the research plans.

3. Societal relevance of research

Rating: 3

The research is potentially of very high relevance. Both the areas of tree/forest modeling and financial market modeling can address important societal issues. Using gaming and gamification to make the models accessible to user groups and have them interact with these is a great idea. However, it needs to be developed further.

4. The consortium and research environment

Rating: 3

The panel sees the following points:

- The team has the necessary collaboration with scientists in both research fields
- Poor gender balance, even though typical in this field, it should be addressed
- Strong dependence on collaborators is a potential risk, although it is nice to see collaboration
- While the link between tree/forest modeling and financial modeling may have strong similarities from a mathematical modeling perspective, it is hard to communicate this to outsiders and is a threat to the apparent coherence of the RC.

5. Suggestions for the future

The panel has the following suggestions:

- The research should be described in the context of complex, emergent systems
- The ultimate use of the models should be (succinctly) elaborated, e.g., use of tree model to estimate harvestable biomass or carbon storage
- Perhaps a wider class of problems that can be address using mathematical modeling and game based learning could be defined including the scientific and practical challenges with the two domains as examples. Alternatively, the RC can select one of the two domains as its main area (we suggest the forest modelin) and transfer financial modeling to e.g .the D2D RC.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 68%, which can be considered as very good coverage, and the bibliometric analysis is reliable. In the research community, there were 11 researchers whose publications were included in the analyses. There were 55 articles, 0 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	55
TCS	330
MCS	6.0

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.24
MNJS	1.15
PP(top10%)	17%
PP(uncited)	24%
Proportion of self-citations	39%
PP(collab)	67%
PP(int collab)	47%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	11	11.45	126	1.07	1	18 %	18 %	36 %	45 %	36 %	60 %
2012	10	5.4	54	0.58	0.82	0 %	10 %	48 %	80 %	80 %	81 %
2013	9	7.33	66	1.3	1.34	22 %	11 %	38 %	44 %	33 %	67 %
2014	13	3.92	51	1.41	0.96	23 %	23 %	35 %	77 %	23 %	66 %
2015	12	2.75	33	1.74	1.62	19 %	50 %	37 %	83 %	67 %	65 %

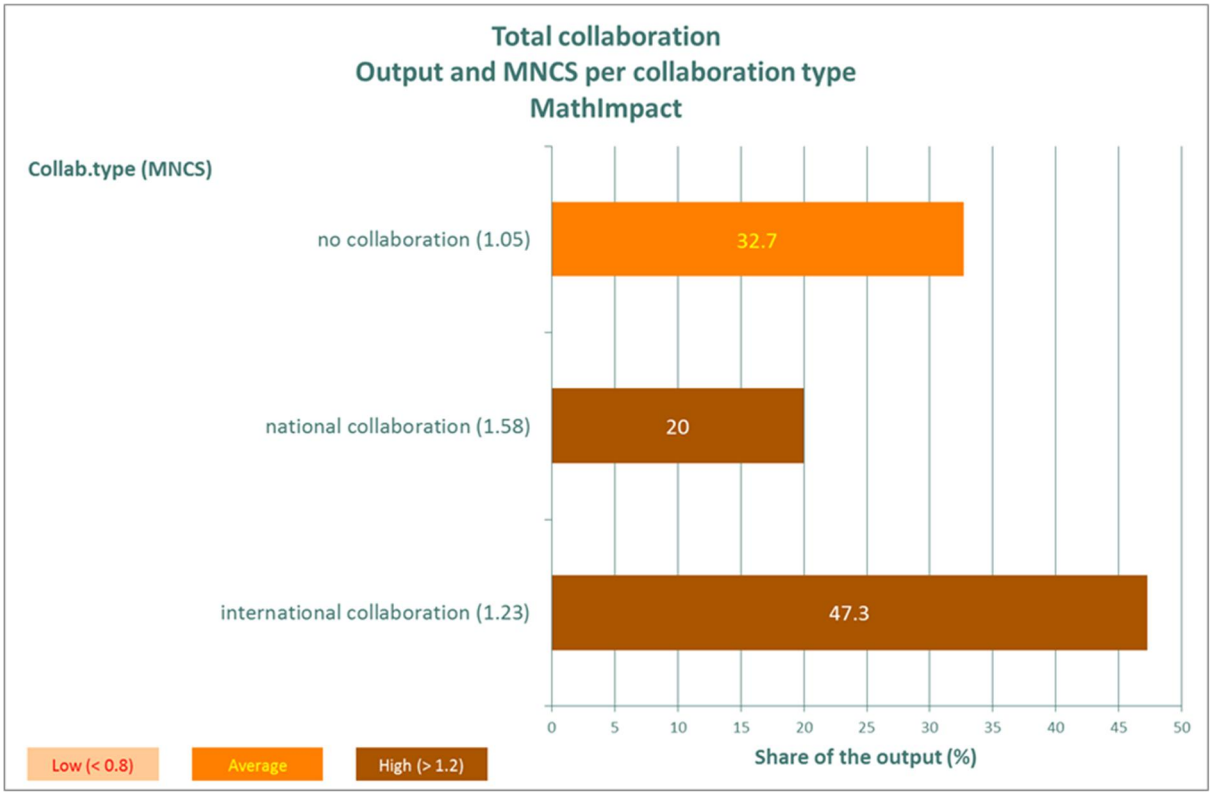


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of the research community is 54%, which is considered as good coverage. However, a great share of publications in the field appear outside the Scopus database. Therefore, the bibliometric analyses should be considered very carefully.

Table 4. Scopus indicators

Indicator	**Performance**
P	108
H-index	14
TCS	1008
MCS	7.5
N-uncited	43
PP(uncited)	40%
Proportion of self-citations	25%

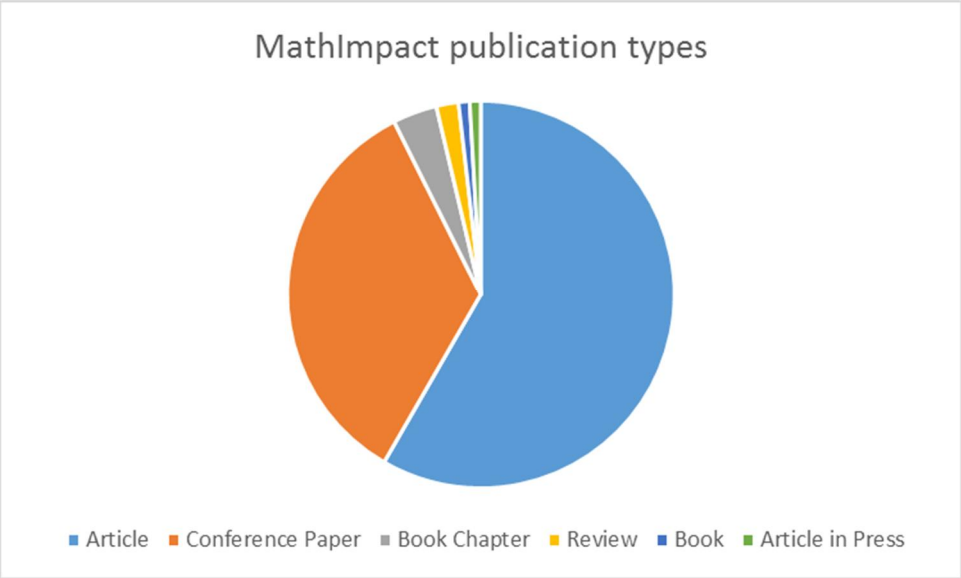


Figure 2. Publication types in Scopus dataset

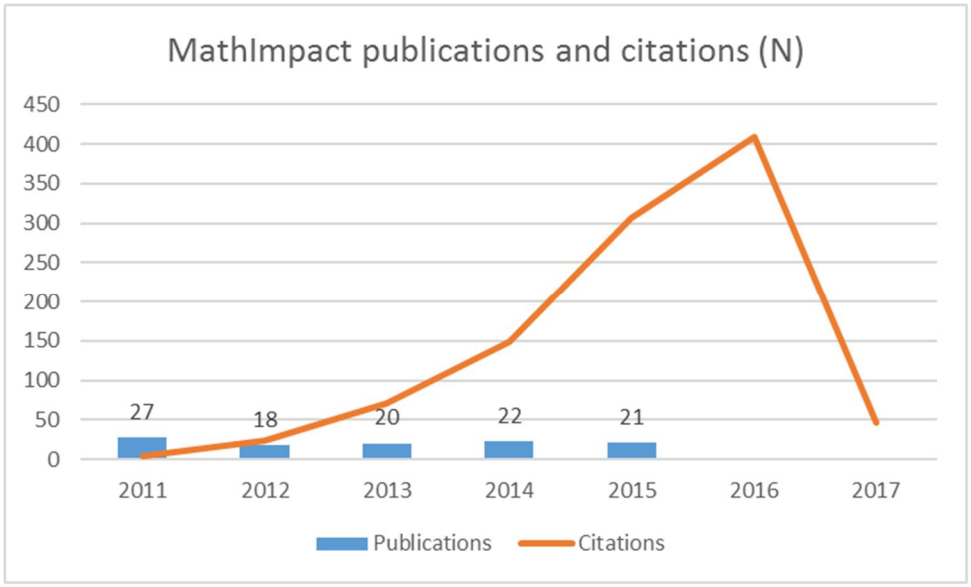


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

4. Multi-scaled biodata analysis and modeling (MultiBAM)

Head of Research Community: Andre Ribeiro

Abstract

Living beings aim to stay alive. To do so, their biological networks of interaction partners constantly process information at various scales, in order to adjust to varying conditions. The key to survival is signaling taking place through processes and having mechanisms that operate over a wide range of different scales. How the signaling processes are bridged to one another between the different scales to generate non-equilibrium dynamics and behavior in living systems remains largely unknown. The MultiBAM community will study biological systems from biodata at different scales of observation and different phenomena. MultiBAM aims to develop novel computational tools to extract and analyze multi-scale empirical data to identify and characterize mechanisms and physical principles that underlie dynamical processes in cells, and, using this pioneering insight, to develop multi-scale models for the given processes. Using this strategy, MultiBAM aims for the following key outcomes in the next 5 years:

• Develop methods and software for processing multi-scale biodata from cells to gain more solid interpretations of cellular phenomena, ranging from temporal observations of single molecules in live cells with fluorescence and super-resolution microscopy to genome wide characterization of all genome alterations and expressed transcripts at the cell population or single cell level.

• Employ machine learning concepts such as Markov chains, random forests and deep neural networks, and develop novel analysis approaches for dynamic phenomena extracted from the data. • Using novel perspectives on how to tune the dynamics of genes and circuits based both on lower and higher level processes, MultiBAM genetically engineers synthetic genes and circuits for sensing and regulating cellular processes.

• Develop novel biosensors, software tools and methods to monitor and control signals in cells, e.g., those based on mechanical response, and evaluate their impact at the molecular level.

• At a higher scale, MultiBAM aims to develop computational models for large-scale dynamical genetic circuits able to, e.g., characterize tumor development at the individual patient level, which is expected to guide the development of new avenues for treatment.

MultiBAM, driven by 4 high-level teams working in unison, is expected to contribute to a better understanding of how biological information flows between different scales in living organisms.

Panel report

1. Novelty of research

Rating: 4

The research approach has a high degree of novelty although other research groups worldwide pursue similar objectives. However, the focus on specific aspects of cell processes may well lead to the identification of a distinct research profile in the years to come.

The multiscale aspect of the research was emphasized in the presentations but more detail could have been given on how analysis across scales is actually going to be carried out.

2. Scientific quality and impact

Rating: 4

The RC will be based on the integration of research groups with a well-established and complementary track record. The latter is supported by excellent publications in international

peer-reviewed journals of high impact factor. The impact of the proposed research in the long-term can be very significant in the identification of new therapeutic targets.

3. Societal relevance of research

Rating: 3 to 4

The societal relevance is potentially very high but can emerge only in the long term if the work will be focussed on specific diseases of wide socio-economical relevance.

4. The consortium and research environment

Rating: 4

Overall this is an excellent consortium offering an excellent environment for early career researchers, who can develop very unique profiles. The groups involved have a good spread of members at different stages of their career and a number of post-docs, who can ensure a solid/competent research output and close supervision of PhD students. The latter seem to be well integrated in the team activities.

5. Suggestions for the future

The RC will need to identify more focused objectives. Although the group is relatively large, there is a risk of research questions being only partially answered. For example, the use of in vitro cell culture models, to obtain bioinformatics data, will need to be carefully considered. Are the researchers going to use cell lines or primary cells? What are the substrates in which they will cultured? What will be the cell density? Are they going to consider co-culture systems to include paracrine effects? If so, expertise in tissue culture is of importance.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 95%, which can be considered as excellent coverage. In the research community, there were 13 researchers whose publications were included in the analyses. There were 154 articles, 4 reviews and 2 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	161.5
TCS	1217.75
MCS	7.54

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	0.74
MNJS	0.93
PP(top10%)	10%
PP(uncited)	17%
Proportion of self-citations	34%
PP(collab)	89%
PP(int collab)	61%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	29	13.24	384	0.73	0.81	14 %	17 %	30 %	97 %	62 %	93 %
2012	34	4.85	165	0.41	0.67	0 %	15 %	48 %	88 %	50 %	94 %
2013	37.25	11.8	439.5	0.95	1.28	13 %	5 %	27 %	89 %	68 %	95 %
2014	34.25	4.3	147.25	0.79	0.91	10 %	23 %	42 %	85 %	64 %	96 %
2015	27	3.04	82	0.83	0.9	15 %	30 %	36 %	89 %	63 %	95 %

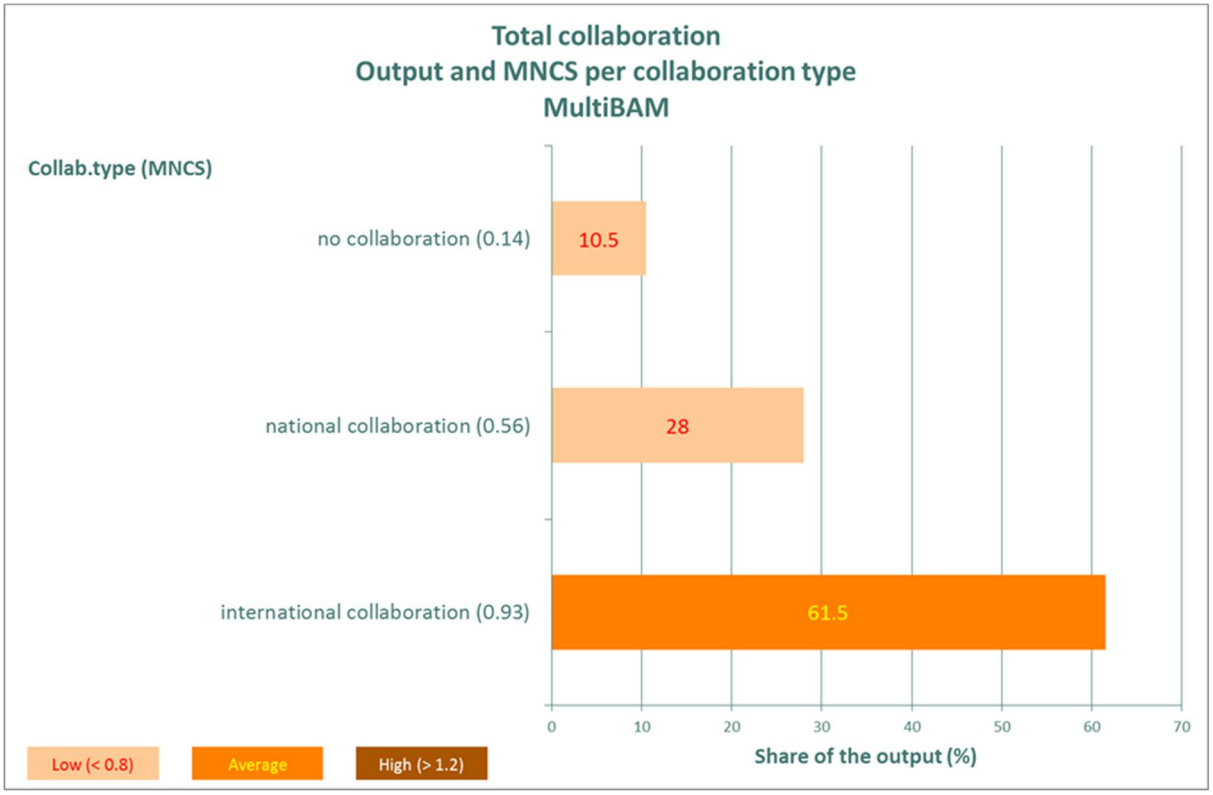


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 91%, which is considered as excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	193
H-index	19
TCS	1654
MCS	8.6
N-uncited	43
PP(uncited)	22%
Proportion of self-citations	32%

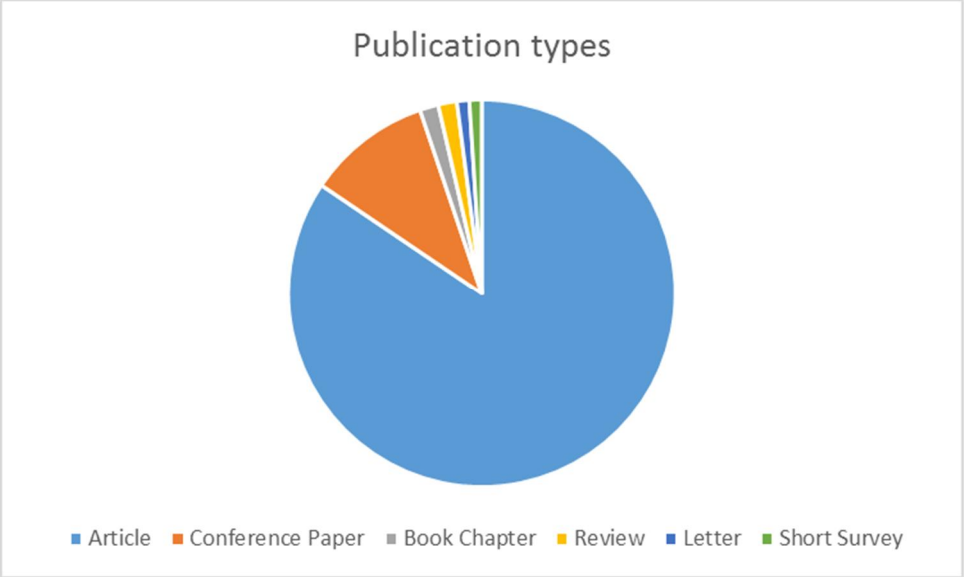


Figure 2. Publication types in Scopus dataset.

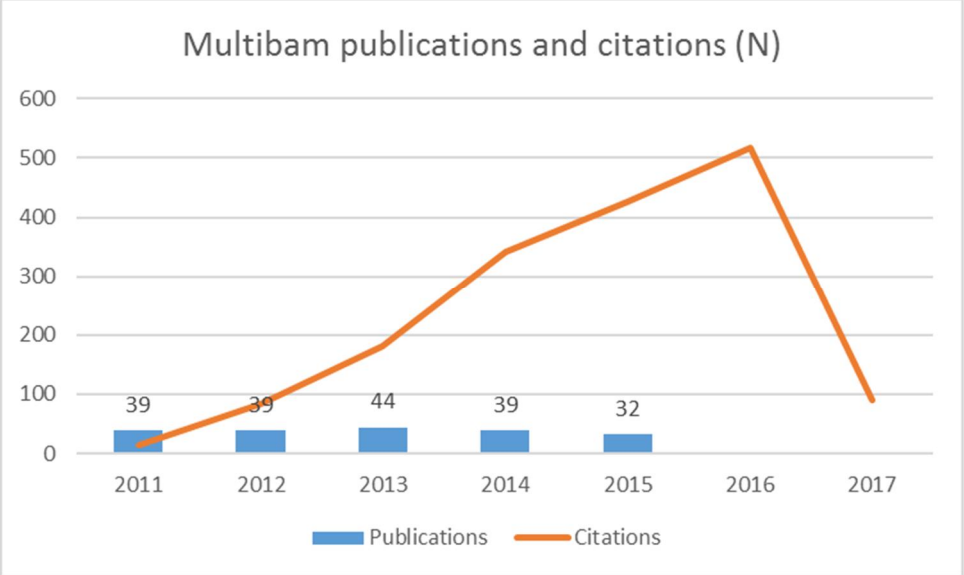


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

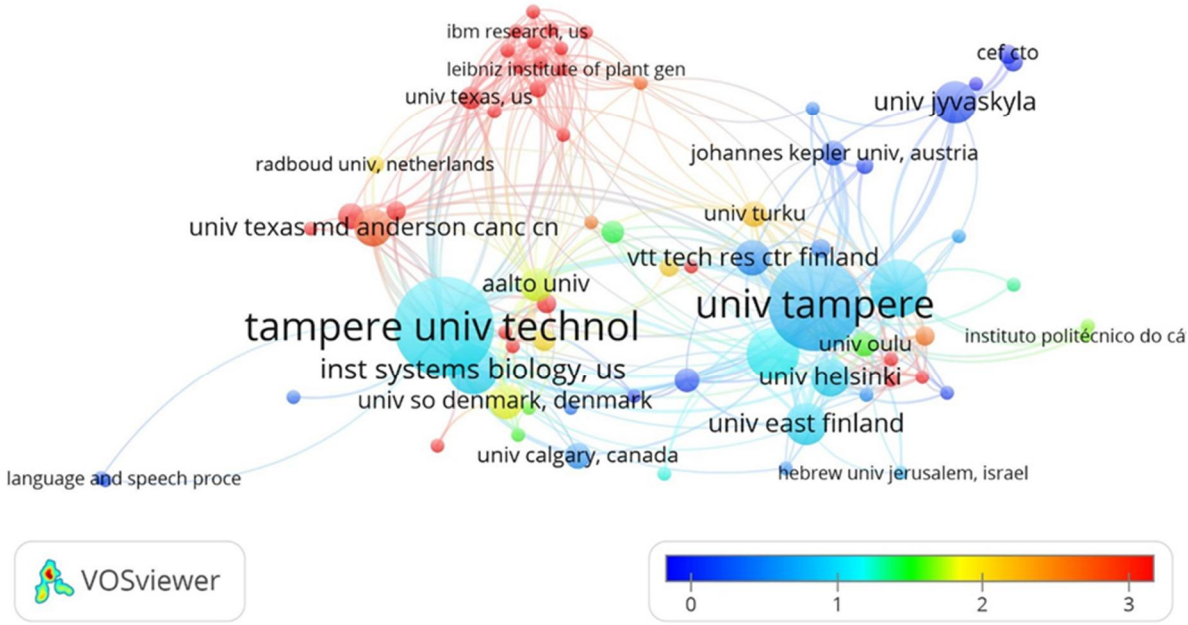


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

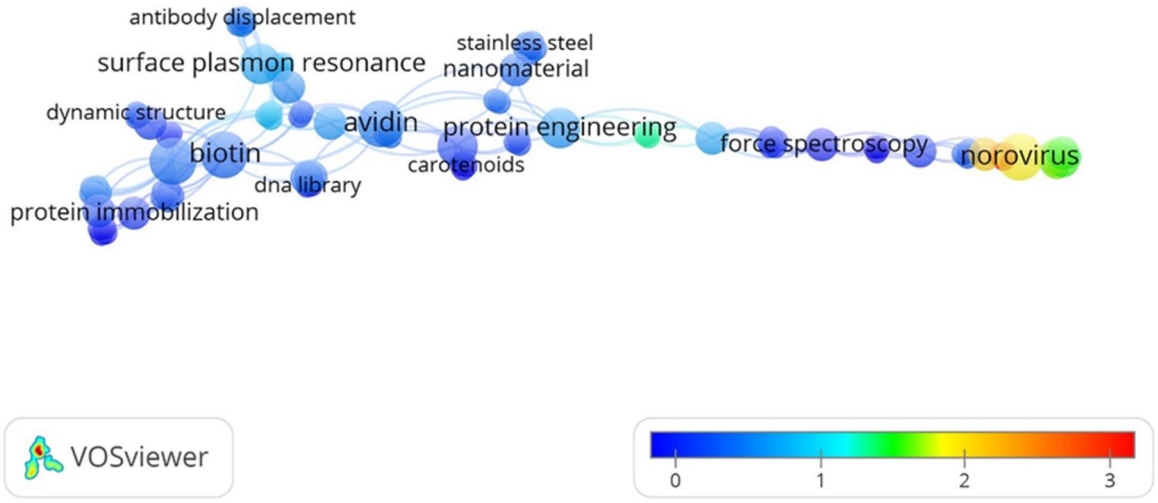


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a universityin a subject category is above average.

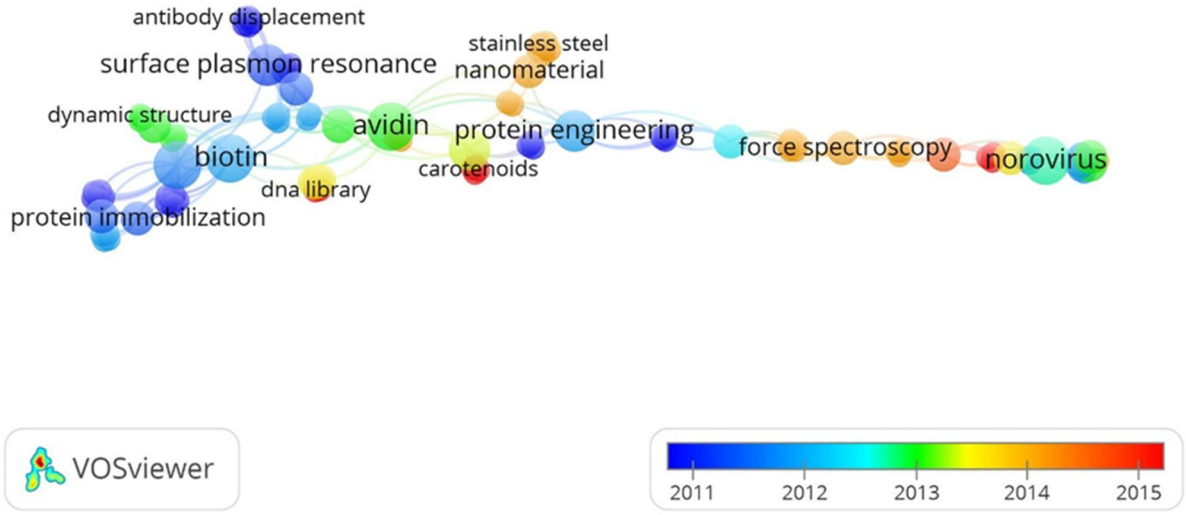


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

5. Regulation of learning and active learning methods (REALMEE)

Head of Research Community: Petri Nokelainen

Abstract

This new research opening studies the effect of various pedagogical interventions on learning in the context of higher engineering education in mathematics, physics, information management and pervasive computing. Pedagogical interventions are conducted in the framework of socio-constructivist learning theory to investigate how regulation of learning and various active learning methods are related to engineering education students' holistic development of competencies throughout their university studies. Interventions are implemented through pedagogical scripting of various online, face-to-face and blended courses in TUT. Examples of such interventions include automatization of learning task assessment, gamification of certain parts of course content and increased collaborative activities. Research aims to produce scientifically robust evidence on factors related to different approaches to teaching and learning in the higher engineering education context.

Panel report

1. Novelty of research

Rating: 3

New learning forms and methods in engineering education (as well as in other academic disciplines) are highly relevant and a focus area for higher education and university development nationally and internationally. REALMEE represents a good and useful addition to the TUT research portfolio.

The RC group showed great enthusiasm for developing, testing and implementing new learning methods related especially to TUT by using own courses for development, testing and implementation of the research. This represents a high novelty and innovativeness for TUT and a potential for excellent contributions to knowledge in this area on a national and international level in a longer time-perspective.

2. Scientific quality and impact

Rating: 3 to 4

The strength of the RC is their well thought out and balanced combination. The group demonstrated a very good knowledge in the field of new learning forms (teamwork, collaborative work, individual studying, e-learning etc.) and other current challenges in education. The mixed method approach, combining qualitative and quantitative analysis using large data sets including learner and teacher data from 'smart rings' combined with smart phone data, holds potential for thorough learning analytics. The studies still have to demonstrate the potential and added value of this data collection system. Several other groups around the world focus on learning, game-based learning, engineering education, effectiveness of on-line courses, learning analytics, etc. The RC has in future to position itself in this arena.

A clearer view of the differences between learning and learning methods at bachelor and master level, as well as relevance to lifelong education, could have been included. Education of teachers to implement new methods should also be considered as part of the plan.

3. Societal relevance of research

Rating: 4

Society faces the challenge of implementing life-long learning effectively. Especially, engineering and technical knowledge and skills are in large demand. Research that makes education in these areas more effective is of eminent importance. The combination of educational science and engineering educators, who are interested and motivated to renew teaching methods, is a key strength.

4. The consortium and research environment

Rating: 4

The RC is a coherent and balanced group of individuals with complementary skills in several relevant disciplines. It is, however, a small group that will be vulnerable to individual changes and lack of resources. Mobility and international connections could be improved.

5. Suggestions for the future

This is a large and growing area with many specialist researchers and communities (e.g. the Game Based Learning community, the Online / E-learning community, the Engineering Education community etc.). However, this RC can contribute substantially through its multidisciplinary nature. The RC needs to carefully position itself and prioritize use of its resources for maximum impact of its strengths in real learning analytics data.

Bibliometric report

Indicators for Scopus data

Internal coverage of the research community is 50%, which is considered as good coverage. However, half of the references are outside the coverage. Therefore the bibliometric analyses should be considered very carefully.

Table 1. Scopus indicators

Indicator	Performance
P	90
H-index	8
TCS	227
MCS	2.5
N-uncited	39
PP(uncited)	43%
Proportion of self-citations	36%

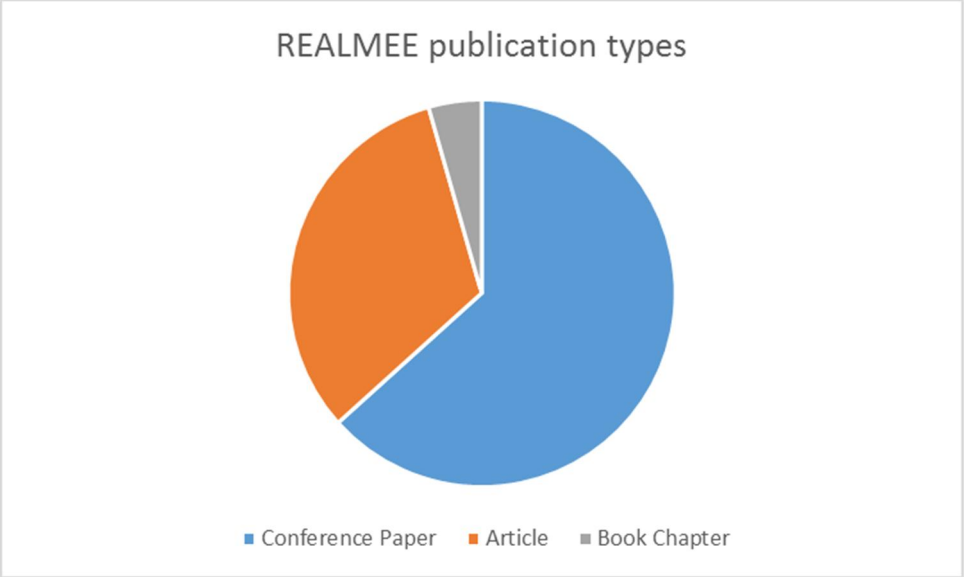


Figure 1. Publication types in Scopus dataset.

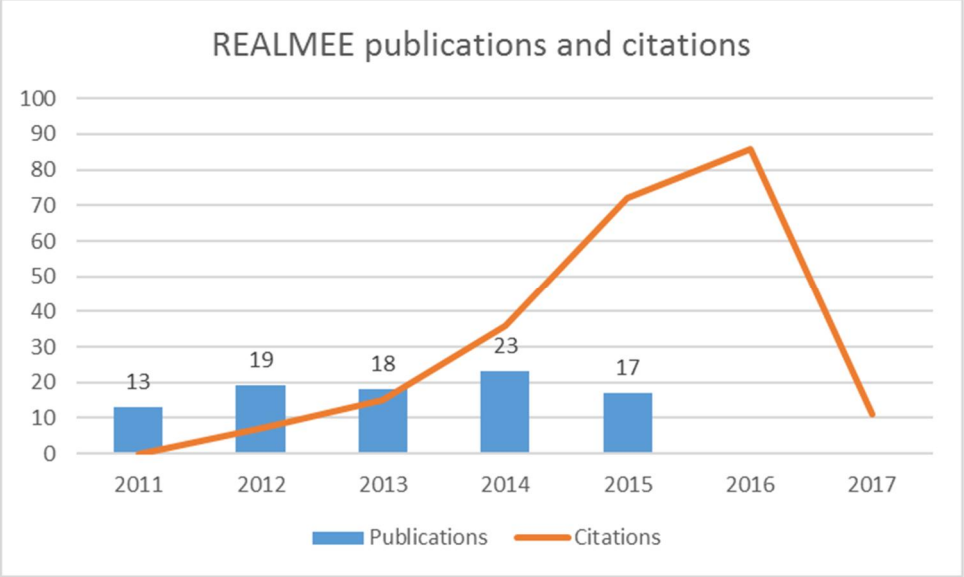


Figure 2. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

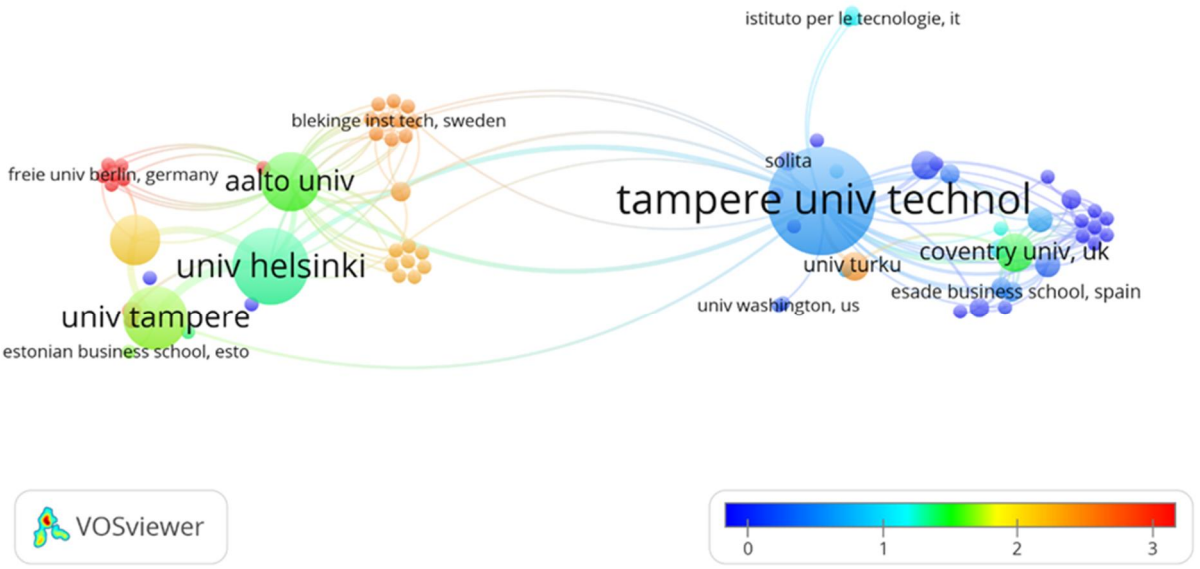


Figure 3. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

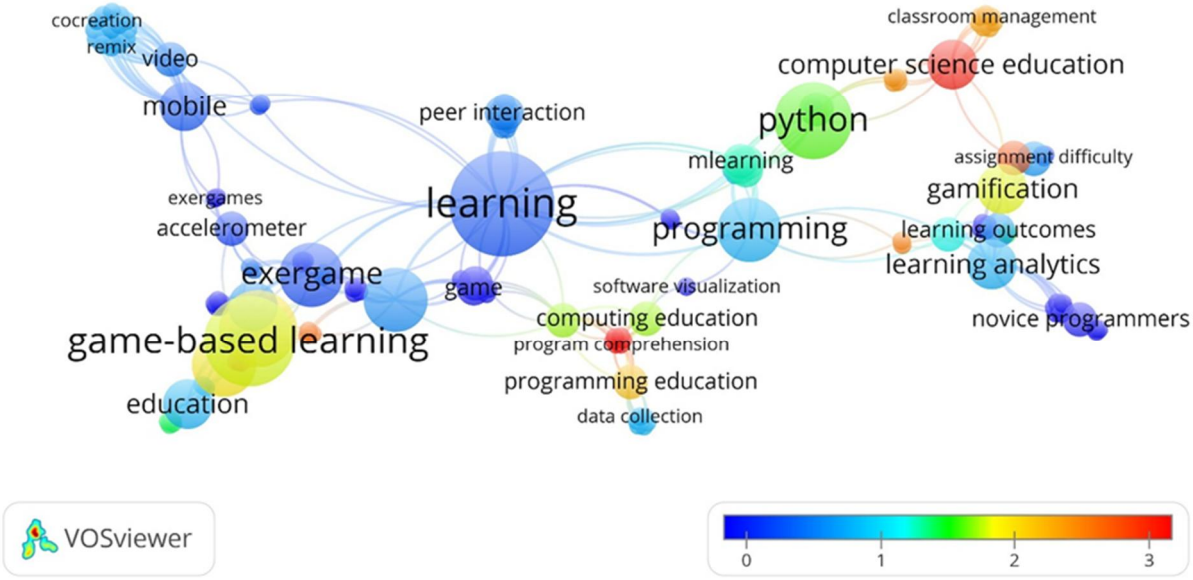


Figure 4. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

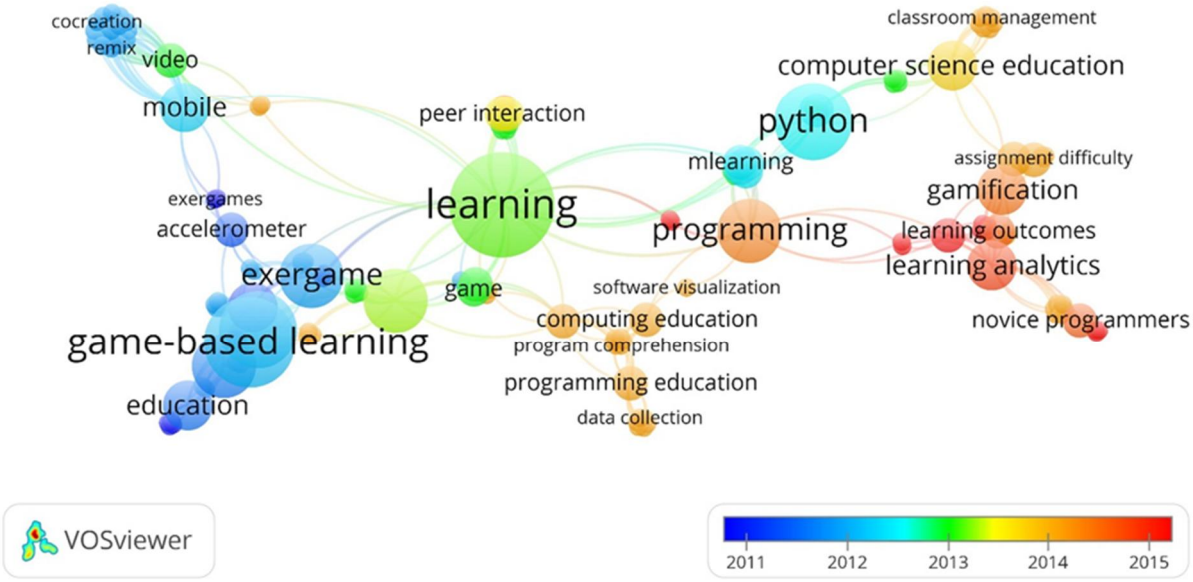


Figure 5. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

ASSESSMENT REPORTS – EXISTING RESEARCH COMMUNITIES

Existing Reseach Communities = established RCs that have co-authored publications and have conducted joint research projects. The RCs assessed in the category of Existing Research Communities were required to meet the threshold of 40 publications necessary for conducting bibliometric analyses based on the Web of Science database.

Research Communities belong to the category of Existing Research Communities:

- Augmented Human Activities (AHA)
- Computational Science X (CompX)
- Engineering materials science and solutions (EMASS)
- Field robotics for efficient work sites (FIRE)
- Frontier Photonics
- Integrated Technologies for Tissue Engineering Research (ITTE)
- Life Cycle Effectiveness of the Built Environment (LCE@BE)
- Managing digital industrial transformation (mDIT)
- Prostate cancer research center (PCRC)
- Research Community on Data-to-Decision (D2D)
- Sensing Systems for Wireless Medicine (MediSense)
- Signal Processing Research Community (SPRC)
- Smart Energy Systems (SES)
- Urban circular bioeconomy (UrCirBio)
- Wireless Communications and Positioning (WICO)

The assessment criteria in the category of Existing Research Communities

Scientific ambitiousness, quality and impact: the scientific ambitiousness, quality and impact of the RC's research, based on the research plan, in terms of originality and significance.

Societal relevance of research: the reach and significance of the research conducted in the RC in terms of the society at large. Are research results relevant to the needs of many user communities? Are the user communities mainly local or global? Do the RC's research questions address globally relevant topics? Is the research conducted in the RC relevant in the production of new knowledge and solutions for, e.g.: business life, civil society, health and welfare, environment or policy-makers, on the national and/or global scale. Please note that even the highest rating does not necessitate a primarily international relevance.

Research environment: the intellectual competence of the RC and its environment, the extent to which the RC provides an adequate environment for research, is engaged with other research communities and is able to attract excellent researchers. More specifically, the panel should consider if the RC has sufficient infrastructure, if the personnel structure supports conducting high quality research, if the RC has a well-balanced funding structure that enables it to fulfil its research plan, if the RC is international in terms of recruiting, networking and

collaboration, if the mobility and networking (national and international) are relevant, and if the RC has a sufficient number of PhD-students to ensure continuity in its field.

Potential of the Research Community: the potential of the RC in terms of its scientific ambitiousness, quality and impact, wider relevance and research environment. More specifically, the panel should consider the following questions:

- what is the potential of the RC's research plan and is the plan feasible?
- does the RC's research work have the potential to make an impact on the scientific community and society at large?
- is the RC aware of its standing in the scientific community?
- how could the RC be more attractive in the eyes of potential new PhD-students and researchers?
- how innovative is the research conducted by the RC?
- how can the university best support the RC?

The panel can also give general recommendations for the RC in terms of the future plans and efforts.

The rating scale

5 – Outstanding
4 – Excellent
3 – Good
2 – Satisfactory
1 – Unsatisfactory

6. Augmented Human Activities (AHA)

Head of Research Community: Kaisa Väänänen

Abstract

In the vision of Augmented Human Activities (AHA) people are empowered by technology solutions that improve their abilities to act in the digitally augmented and natural environments. The purpose of AHA is to improve people's efficiency and well-being in various activity domains. AHA RC explores transformed ways to perform activities by extending people's senses and by enriching their interactions with technology and with other humans. Augmentations support emerging technology paradigms like smart environments, intelligent personal technology and combinations of networked devices and sensors. These are enabled by research in the fields of interaction models and methods, wearable sensors and actuators, printable and organic electronics, very small computers and device-to-device networks. Internationally, AHA is a part of the emerging research area Augmented Human where AHA can be one of the major actors, with a special emphasis on multidisciplinarity.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 2 to 3

The AHA have an ambitious vision "to improve people's life quality by developing novel augmentation technology that is based on thorough understanding of human needs and validated by controlled experiments and user experience evaluation". However, the research plan does not match this vision and it is not clear how important contributions to the field will be made. A clearer description of the technical problems that should actually be solved would have been an advantage.

Given the participants earlier contributions, it seems likely that the RC will result in research that provides useful knowledge, but they do not presently appear to be internationally leading in the field. The number of publications is fine, but they should aim to have more impact.
The focus areas and research questions are mainly framed as social science or public management problems and less based on the technical disciplines to which the participants all belong. The research outcomes are therefore not sufficiently well grounded.

2. Societal relevance of research

Rating: 4

The stated purpose of AHA is to "improve people's efficiency and well-being in various activity domains" is obviously a major theme in modern society. The stated focus areas of AHA research in augmentation of "wellbeing and healthcare, work and industrial environments and everyday life activities", covers a very broad area and reaches practically all citizens. It is expected that in the future the RC more clearly develops new knowledge and finds solutions that benefit the society significantly.

3. Research environment

Rating: 3

The consortium is large and rather diverse in the respective specialization. Of the 11 listed senior participants only some have an h-index above 20. Although the common focus on

augmented human activities could lead to synergies, it is a concern that most participants in their earlier career have been rather narrowly focused.

4. Potential of the Research Community

The focus on people's efficiency and well-being in this research represents an undeveloped possibility for a stronger focus on the user experience, developed from a stronger integration and multidisciplinary approach through cooperation with experts from humanities and social science. This could represent an important development in health and welfare technologies.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 68%, which can be considered as very good coverage, and the bibliometric analysis is reliable. In the research community, there were 34 researchers whose publications were included in the analyses. There were 126 articles, 2 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	128
TCS	494
MCS	3.86

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	0.76
MNJS	0.82
PP(top10%)	6%
PP(uncited)	20%
Proportion of self-citations	30%
PP(collab)	64%
PP(int collab)	36%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	28	4.68	131	0.53	0.68	0 %	14 %	31 %	57 %	29 %	60 %
2012	29	5.45	158	0.8	0.77	5 %	7 %	22 %	66 %	48 %	72 %
2013	27	2.81	76	0.57	0.49	4 %	33 %	34 %	59 %	26 %	65 %
2014	27	3.33	90	1.11	1.35	9 %	15 %	40 %	67 %	41 %	69 %
2015	17	2.29	39	0.82	0.78	12 %	41 %	24 %	76 %	35 %	78 %

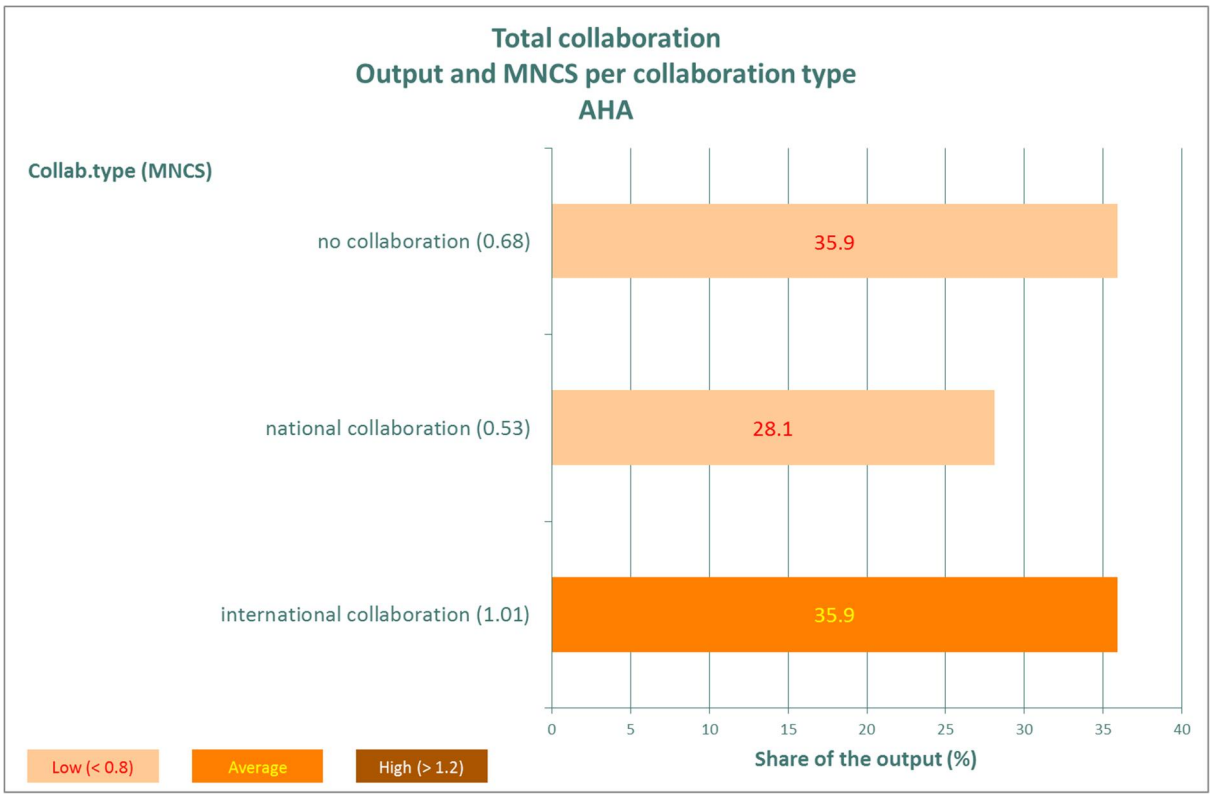


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of AHA research community is 59 %, which is considered as good coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	405
H-index	16
TCS	1263
MCS	3.12
N-uncited	167
PP(uncited)	41%
Proportion of self-citations	30%

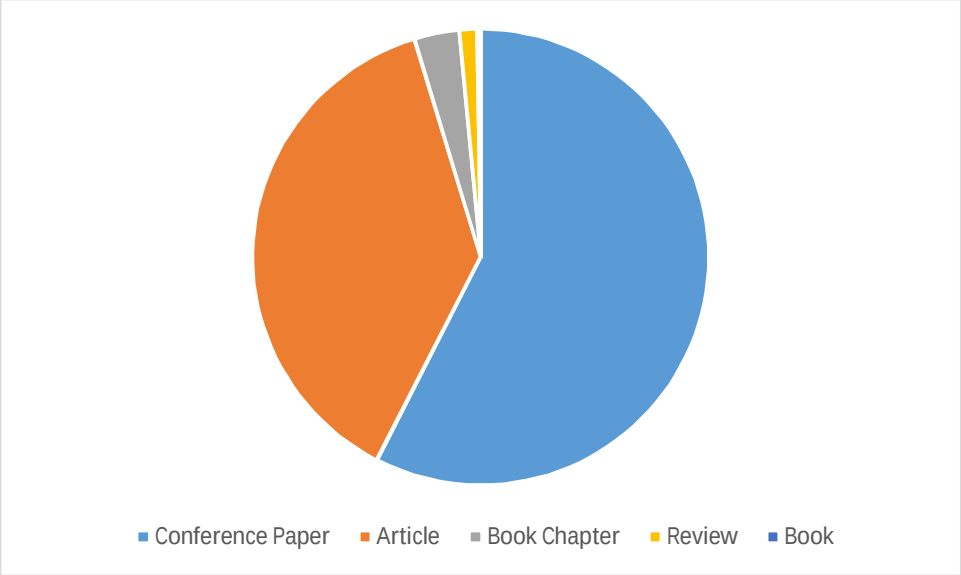


Figure 2. Publication types in Scopus dataset

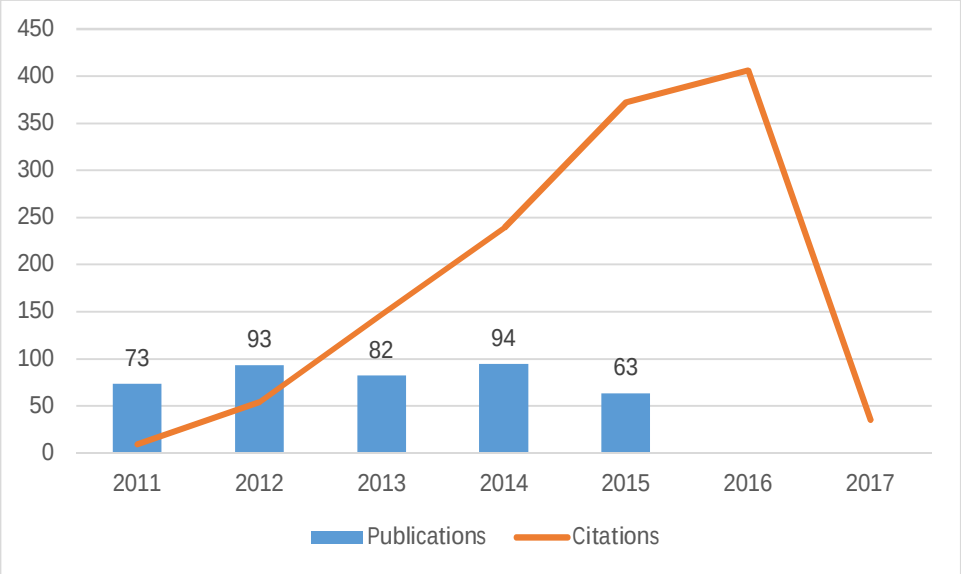


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

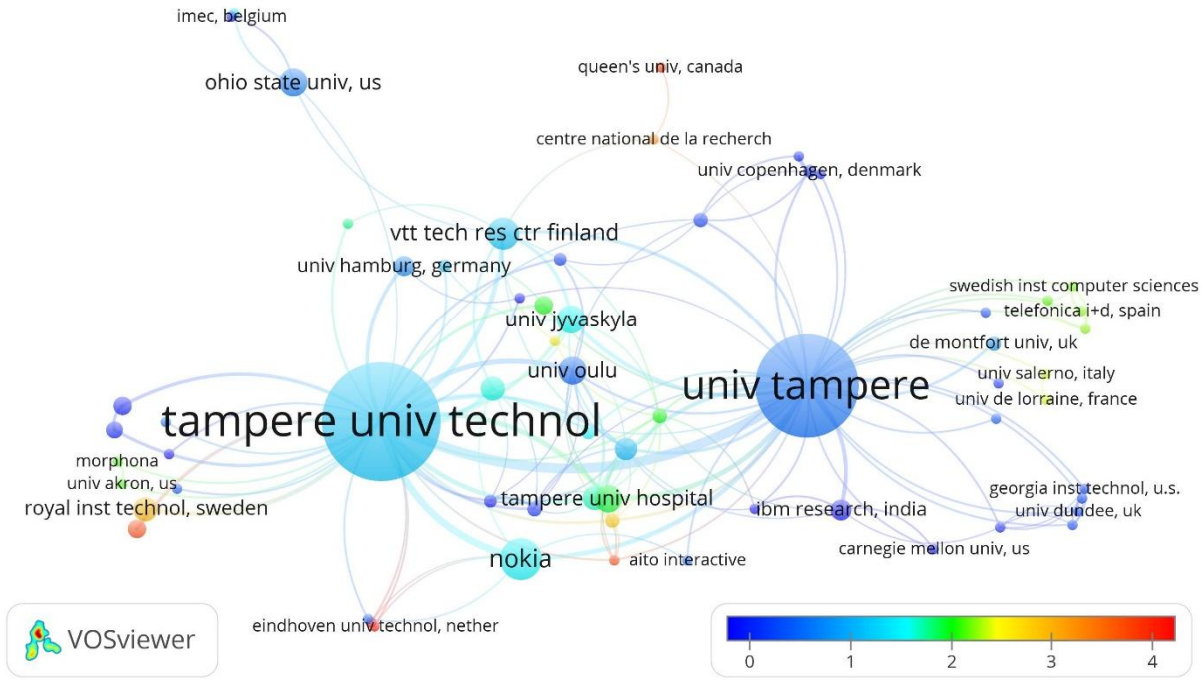


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

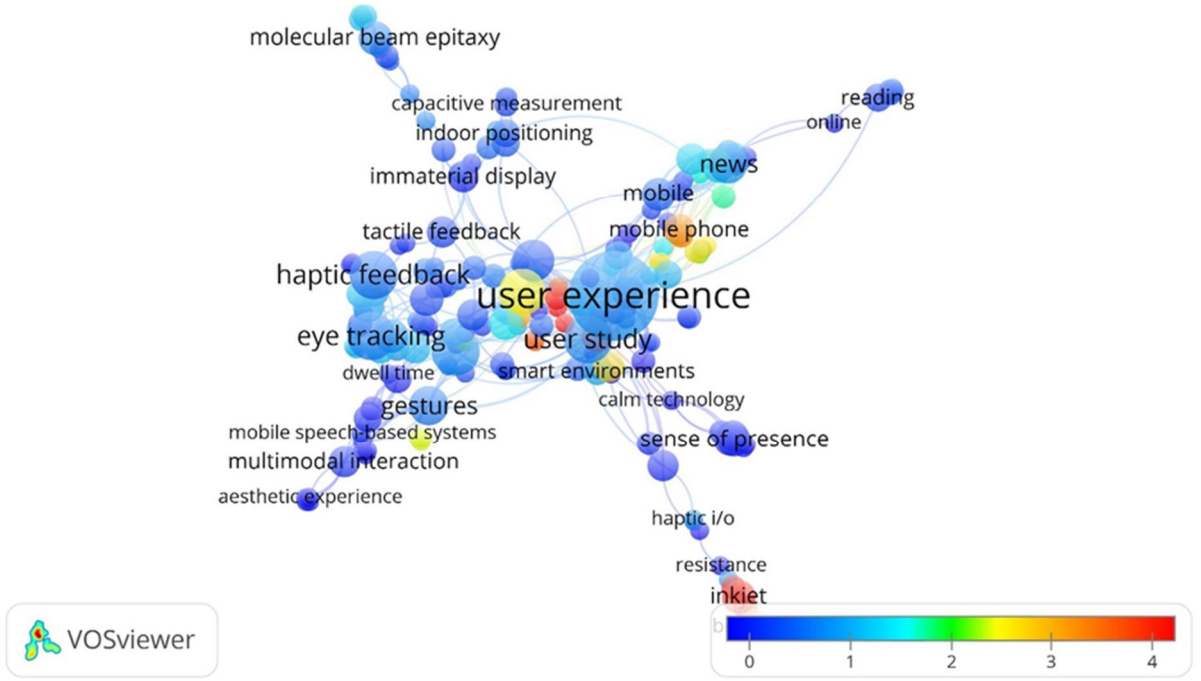


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

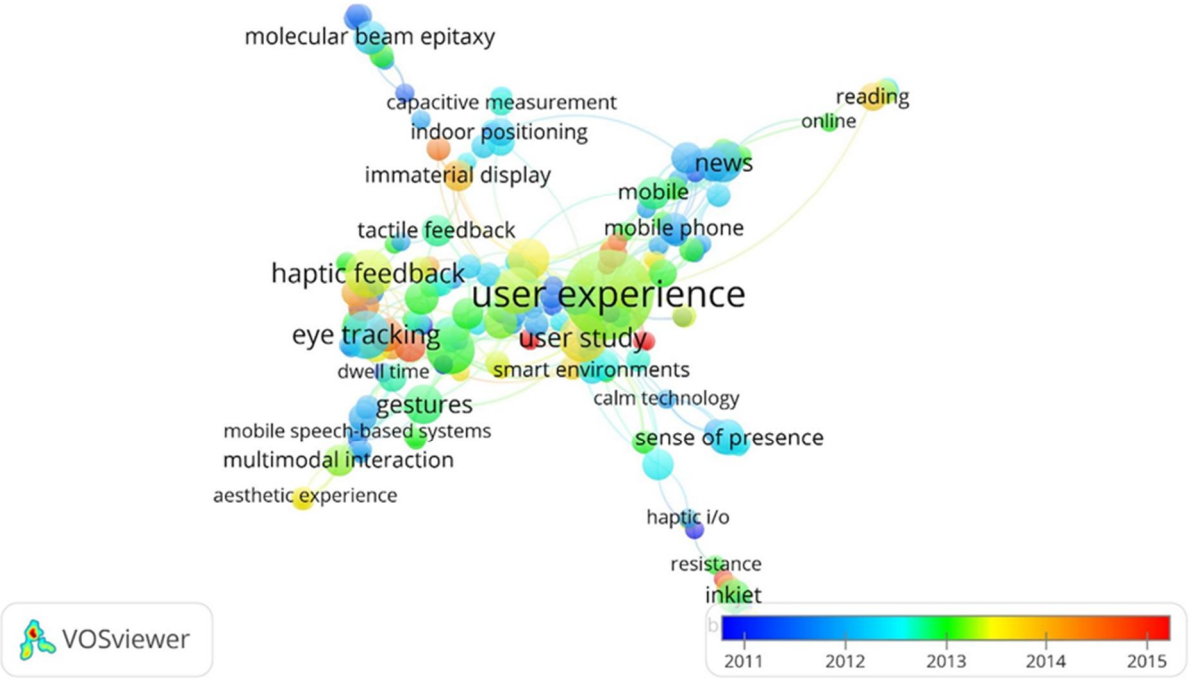


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

7. Computational Science X (CompX)

Head of Research Community: Esa Räsänen

Abstract

Computational science is one of the cornerstones of modern scientific research and it can be found everywhere: in mobile phones, cars, health care, transport logistics, and weather forecasts. In economy, more and more applications are based on computational science. The analysis of the so-called Big Data is a profound example of this trend. At the same time, the data available to us is becoming more and more complex, setting extremely high standards to the models and computational methods needed to analyze and exploit the data. Our Research Community (RC) CompX tackles multidisciplinary challenges, while keeping the scientific core at excellence in numerical physics. We (i) bring added value to experimental findings through both interpretation and prediction, (ii) unlock the complexity of materials and systems through computer simulations, and (iii) develop efficient analysis packages for Big Data problems. The common denominator in CompX is the methodological development, which we do together. As the applications of the methodology can be chosen freely, our RC collaborates in a very wide spectrum, as long as the project has potential to provide high gain. The impact of CompX is threefold. Firstly, we foster an outstanding training environment, where skilled professionals at all researcher stages are employed to prestigious positions worldwide. Secondly, we generate high-impact science as already demonstrated by our publication output, top-level international collaboration, and widely distributed numerical codes. And finally, we build strong strategic support to TUT by striving for multidisciplinary projects with other local high-level research groups. This includes the strategic directions in health, energy, digital environment, and light-based technologies, as well as new openings in e.g., signal processing, biomedical applications, and financial engineering.

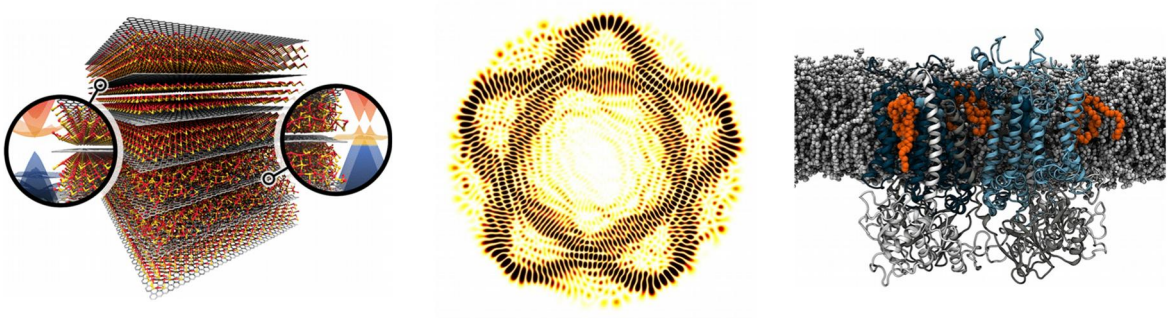


Figure: Three examples of recent research problems tackled in CompX. Left: Multilayer system comprising crystalline and amorphous phase-change-material films [Akola Group, 2016]. Middle: “Quantum scar” on a highly-excited eigenstate in a semiconductor nanostructure [Räsänen Group, 2016]. Right: Cytochrome bc1 protein complex as a part of the respiration cycle in mitochondrion, thereby contributing to the production of ATP for cell survival [Vattulainen Group].

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

The RC was presented in Tampere under the title of Computational Physics X, which indeed fitted the activity as presented better than the more general name Computational Science X.

The RC presented a number of computational physics techniques of which the most prominent were molecular simulation and modelling, quantum dynamics, time series analysis, density functional methods, and optimization on the quantum domain. The consortium as a whole is clearly at the forefront in several of these methods and applications. Three exciting examples were presented (a) modelling of hydrocarbons in the human gut; (b) a computational study of molecular graphene (c) time-series analysis and fractal patterns in drumming with a planned follow-up on human heart beats.

The RC also highlighted data science as a new paradigm and machine learning as a new technique to enhance other methods but without in-depth treatment or awareness of the respective advantages and disadvantages of such methods. To make impact on an international level in this direction they need to develop collaborations with strong methodological groups in machine learning, or build up their own expertise in this field.

2. Societal relevance of research

Rating: 4

The RC has an orientation towards real-world problems investigated by the methods of computational physics. The previous track record of the RC participants and the projects presented give grounds to expect that RC will deliver significant societal impact in the future.

3. Research environment

Rating: 4

The RC lists four senior participants. The overall quality of the consortium is excellent. There is a concern how sustainable this RC is at TUT given other engagements of several of the leading participants.

The consortium of the RC made a very favorable impression on the committee as to its enthusiasm and willingness to address new problems. The described practice to induct young students into research at an early stage is commendable and the results achieved as to publications of early career scientists and even by students at the MSc stage are impressive.

4. Potential of the Research Community

The potential of the research community is at present highly dependent on its future composition, which in turn depends on recruitment strategy for the opening of new professor positions.

The RC in the presentation demonstrated a very positive attitude to involving graduate students as well as master students in research. The potential of the RC involvement and committment to teaching on a high level appears high.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 94%, which can be considered as excellent coverage, and the bibliometric analysis is reliable. In the research community, there were 22 researchers whose publications were included in the analyses. There were 191 articles, 2 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	193
TCS	1436
MCS	7.44

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.14
MNJS	1.23
PP(top10%)	13%
PP(uncited)	30%
Proportion of self-citations	17%
PP(collab)	93%
PP(int collab)	79%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	36	13.89	500	1.53	2.03	20 %	17 %	31 %	86 %	81 %	94 %
2012	41	8.51	349	1.04	1.09	5 %	12 %	29 %	90 %	78 %	95 %
2013	33	8.21	271	1.11	1.04	18 %	6 %	24 %	97 %	73 %	94 %
2014	42	5.14	216	1.1	1	14 %	17 %	35 %	93 %	83 %	95 %
2015	41	2.44	100	0.97	1.04	10 %	32 %	32 %	98 %	80 %	94 %

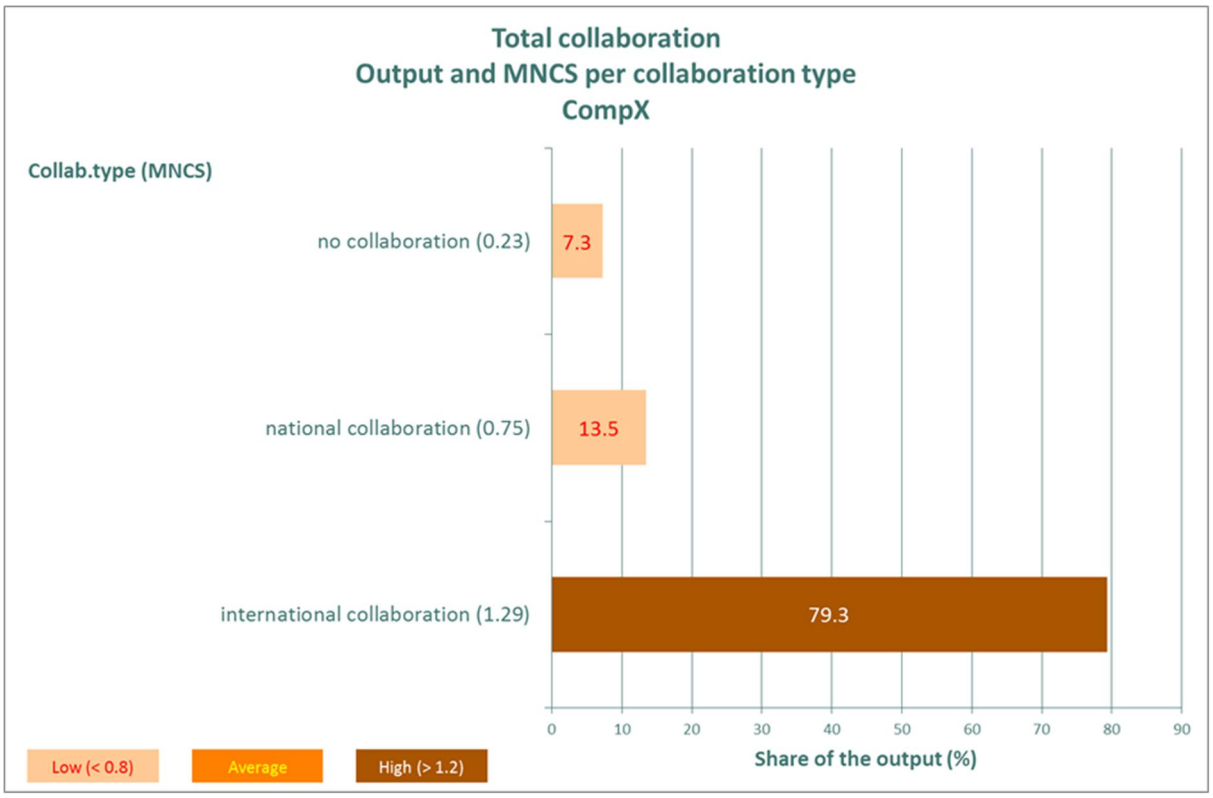


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of the research community is 88%, which is excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	350
H-index	29
TCS	3592
MCS	10.3
N-uncited	55
PP(uncited)	15%
Proportion of self-citations	25%

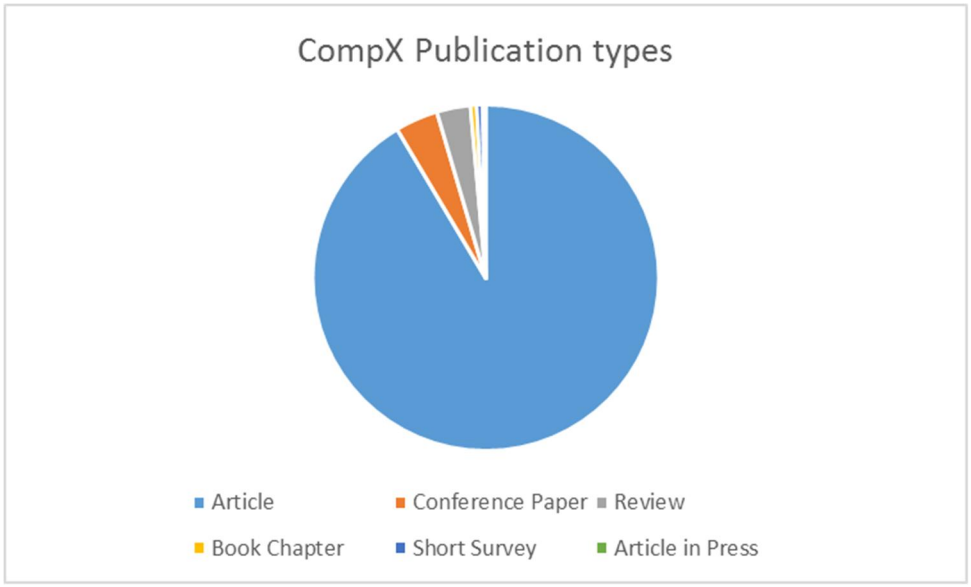


Figure 2. Publication types in Scopus dataset.

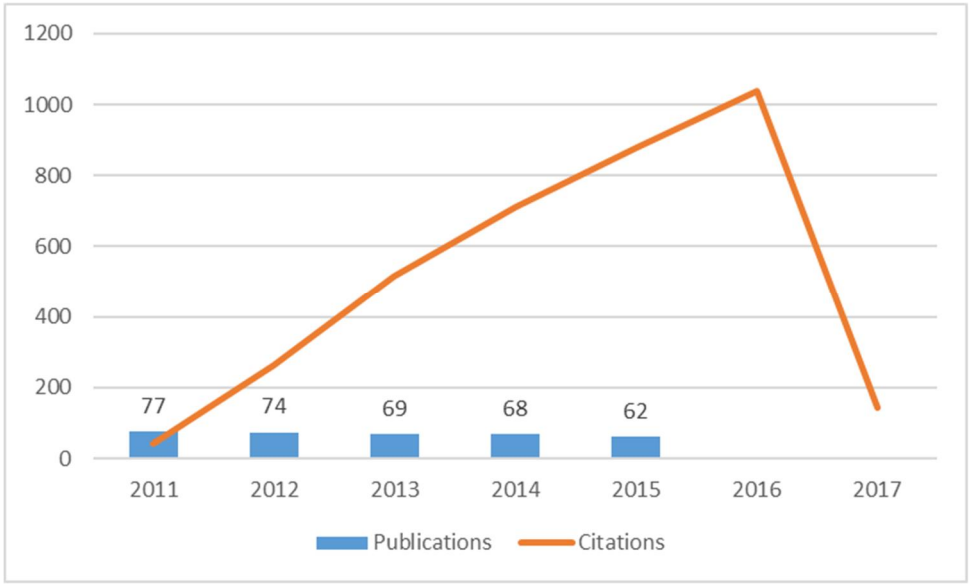


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

8. Engineering materials science and solutions (EMASS)

Head of Research Community: Erkki Levänen

Abstract

The research community (RC) gathers together active research groups, who are dealing with engineering materials, especially their surfaces and interfaces. Within this theme, the RC consists of a wide range of varying scientific disciplines based on natural as well as engineering sciences. The RC is acting on a research field, which strongly supports the Finnish (export) industry, providing the ability to gather prominent external funding. The RC size of 91 researchers with 414 (Scopus) refereed journal articles during the years 20112015 gives a good basis for aiming at a leading role in the international level in the area of engineering materials. The RC's versatile and modern research facilities and special built research environments form a unique entity fulfilling high international standards.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 3 to 4

Although this is an important area of research and requires both high quality and impactful research, the RC has made their focus in a narrowed manner on materials processing, characterization and performance evaluation. The team is strong with several distinguished professors. However, an integration of such a relatively large number of researchers allowed this RC to set their scientific objectives to primarily investigate materials properties, coatings, aerosols, surface treatments, etc. to overcome issues, such as friction, wear and corrosion. It could have been better for this RC to more aggressively cover device making activities, multifunctional and smart materials (including hydrophobic and dust repellant surfaces). Although the main research lines and proposed approaches appeared to be strong and compelling, the scientific ambitiousness was not exceptional enough. The RC has made their primary focus clear in the presentation and the research outcomes is published in journals with relatively high impact factors. The research comprising many aspects and applications of material science is likely to produce impacts at both scientific and industrial level if they enhance their activities for more focused applications.

2. Societal relevance of research

Rating: 4

The societal relevance of this research is quite high. The knowledge gain in the field of material with applicability in so many fields of innovation suggest that this RC will be able to generate science, consultancy and IP in industry at large. However, the research priorities are not clearly spelt out. The RC is expected to focus more on the improved performance of engineering materials and their surfaces, innovative multifunctional materials and manufacturing technologies, as emphasized in their proposal which may lead to a world-leading cluster.

3. Research environment

Rating: 4

The RC brings a complementary expertise and a very sound research track record in terms of publications and funding. The research environment is well balanced also in terms of researchers at different stage of their career and it is impressive in their strong research fellow

base that gives re-assurance about the ability of the whole RC to produce robust research, competent consultancy to third parties and close supervision of PhD students. In addition, the members of this RC have established some international cooperation, primarily in the form of visits and mobility, with various universities and labs.

4. Potential of the Research Community

This RC has the potential to step up to become a world-leading team. They will certainly produce a highly competitive critical mass in Finland and be very recognised at international level in the field of material science if they further enhance their activities as outlined above and partnerships locally and internationally. Overall, this is a very interesting RC.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the EMASS research community is 85%, which can be considered as excellent coverage, and the bibliometric analysis is reliable. In EMASS research community, there were 30 researchers whose publications were included in the analyses. There were 291 articles, 13 reviews and 1 letter in the set of publications of EMASS.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	304.25
TCS	2225
MCS	7.31

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.22
MNJS	1.20
PP(top10%)	13%
PP(uncited)	17%
Proportion of self-citations	26%
PP(collab)	78%
PP(int collab)	39%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	42	14.74	619	1.21	1.21	14 %	17 %	25 %	74 %	19 %	85 %
2012	54	9.57	517	1.25	1.2	16 %	4 %	30 %	78 %	44 %	83 %
2013	62	8.13	504	1.19	1.15	12 %	13 %	23 %	77 %	32 %	87 %
2014	76.25	5.4	412	1.22	1.26	14 %	17 %	25 %	79 %	43 %	83 %
2015	70	2.47	173	1.25	1.17	11 %	29 %	27 %	79 %	47 %	85 %

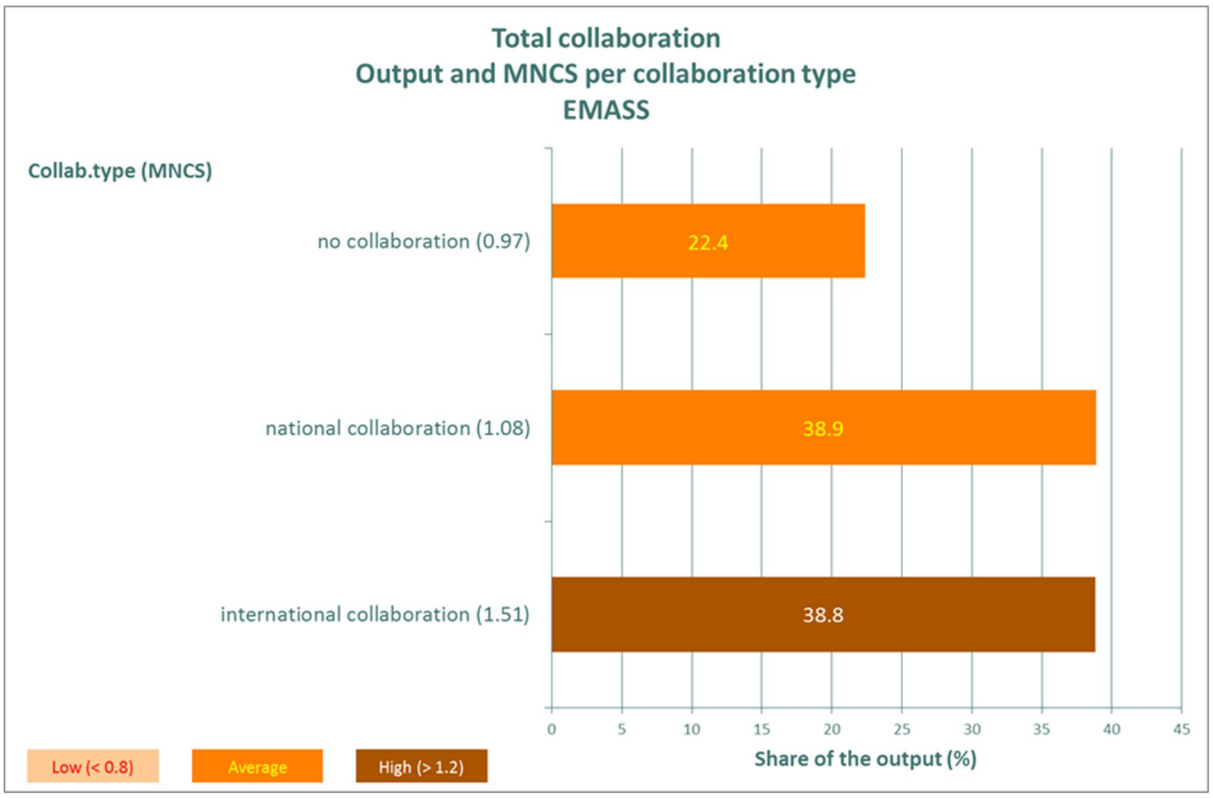


Figure 1. Collaboration profile for EMASS (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of EMASS research community is 80 %, which is excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	404
H-index	25
TCS	2828
MCS	7
N-uncited	129
PP(uncited)	32%
Proportion of self-citations	25%

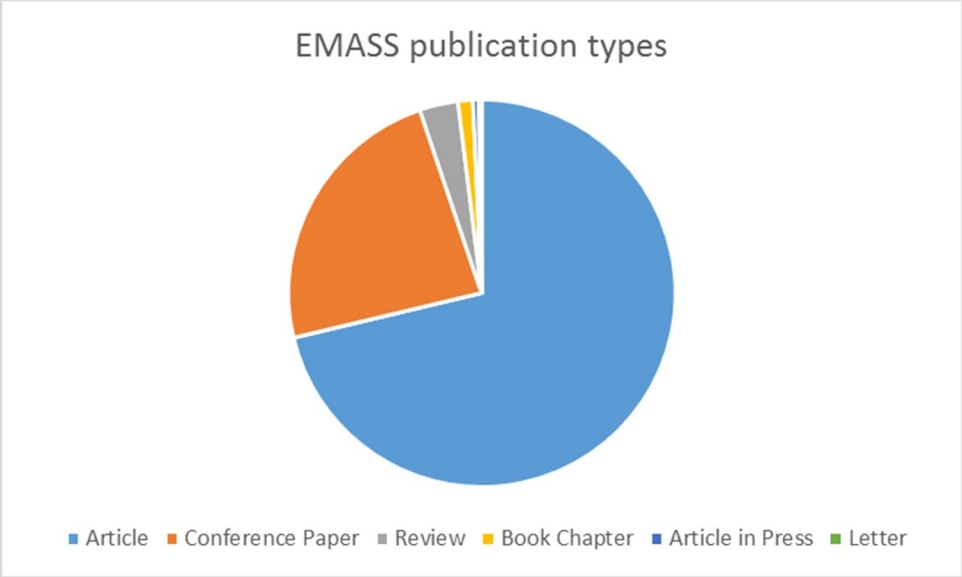


Figure 2. Publication types in Scopus dataset.

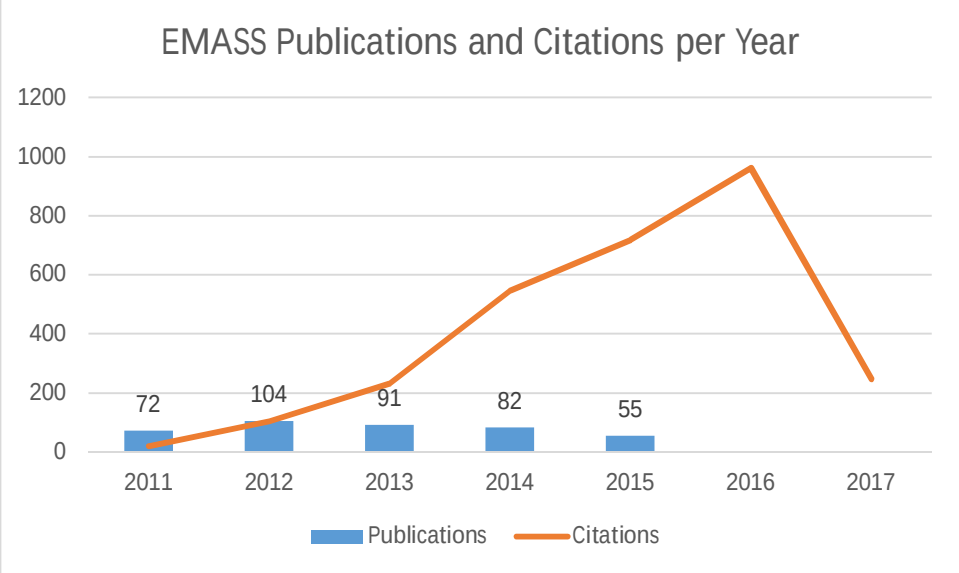


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

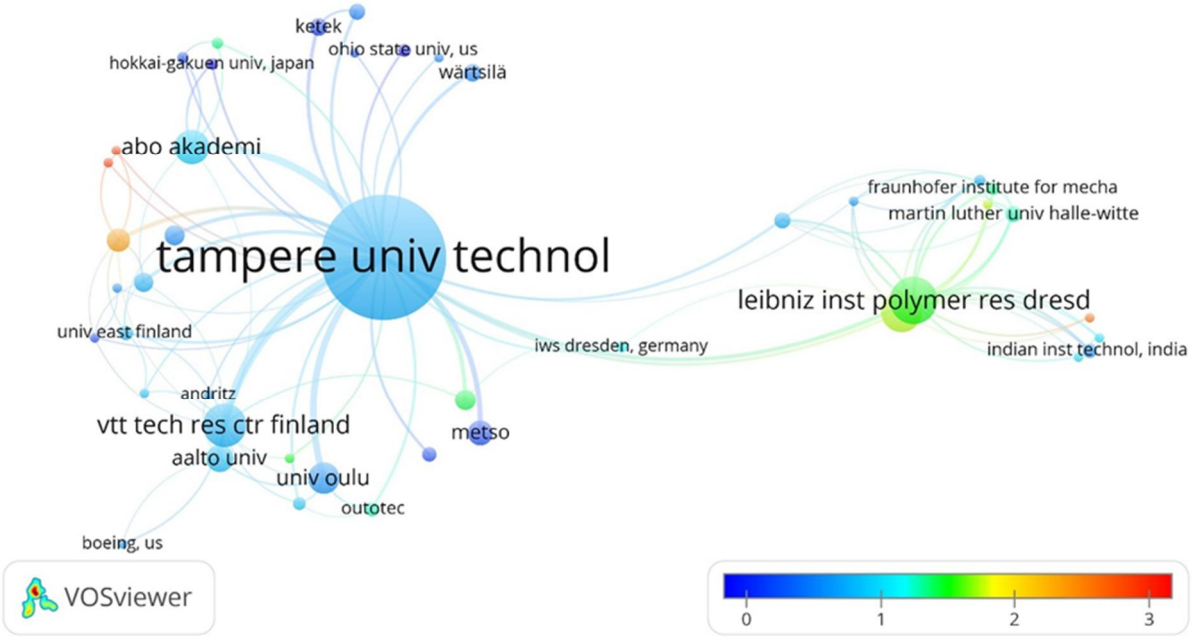


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

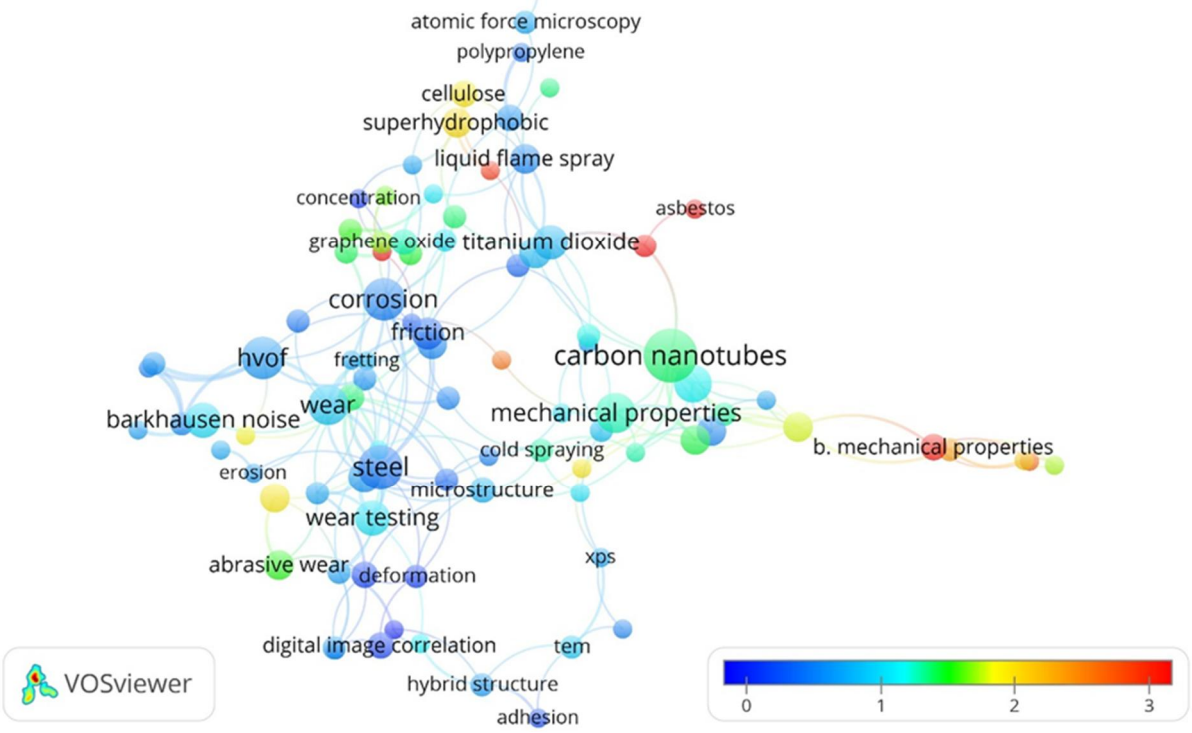


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

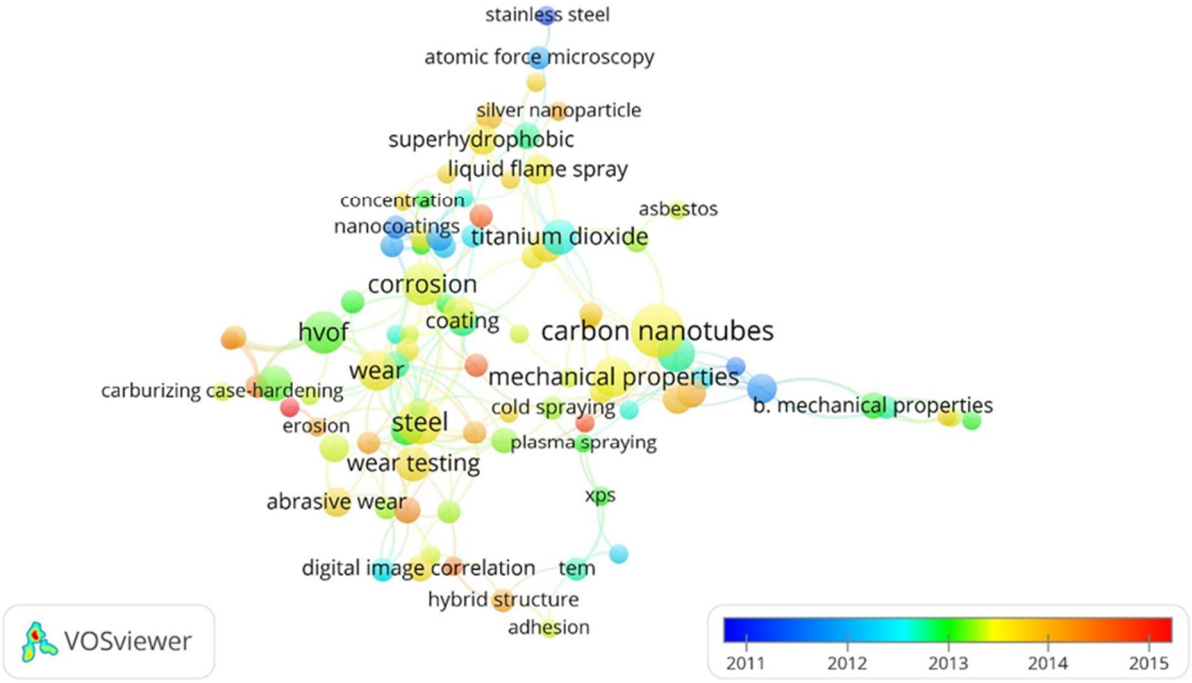


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

9. Field robotics for efficient work sites (FIRE)

Head of Research Community: Kalevi Huhtala

Abstract

FIRE Research Community (RC) strives to develop the technology of autonomous worksites where heavy autonomous machines and humans work as teams. Before the autonomous worksite will be reality, advances in many disciplines are required. Algorithms for task planning and distributed cooperation must be enhanced. Communication between machines and between humans and machines must be accurate and reliable. Machines and worksites must be equipped with sensing systems to perceive the situation and potential safety concerns. The plans must be executed with accurate real time control of the motion of the machines. The motion must be provided with the energy efficient actuation. FIRE gathers researchers who, with their complementary state-of-the-art expertise, cover this multi-disciplinary area of research. FIRE is formed to pursue holistic research into heavy-duty field robots, and participating research groups, which have already collaborated in several basic and applied research projects. FIRE seeks both high scientific and societal impact. Our research questions are generic to foster significant scientific advances and result in high impact joint publications. Our contacts to the machine manufacturers in Finland and globally provide avenues of rapid uptake of technological advances in field robotics for e.g. mines, construction sites, harbors, forests, and disaster rescue sites.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 2 to 3

The RC mainly consisted of hydraulic and automation scientists and remained in this area. It needs to expand and enhance their activities to get into true robotics topics to bring technological solutions. The RC has done a thorough SWOT analysis to identify their strengths, weaknesses, opportunities and threats, which deserves a clear recognition. However, they did not develop an action plan to overcome these weaknesses and threats. The scientific impact and publications of this research community are relatively weak, and it is not clear what its special research areas are. It proposed a few very interesting research topics, on autonomic robots for mining, forestry, shipyard, etc., but not much work has been done yet. It needs a concrete action plan to address the issues raised in the SWOT analysis for the community to grow. In particular, it needs to utilise its strength to identify its key research areas, be ambitious, target its publications to high impact journals and conferences in the targeted areas, and establish partnerships with other robotic groups locally and internationally.

2. Societal relevance of research

Rating: 3

This RC has a track record of working closely with some industries established locally and much of its research and knowledge have transferred to its collaborative partners through essentially services. Some of its work on improving efficiency of heavy machinery could have great potential, but it has not considered alternative energy solutions and energy management. It could make significant impacts on the local economy by identifying the key problems and focusing its research to develop the solutions, for instance, autonomic heavy machineries and robots for harsh environment. Its work could lead to lasting effect on the

environment if it can consider energy efficiency, power management, power optimisation and thermal insulation in its research in heavy machineries. The community and its members could be benefit by establishing strong collaborations with other robotics groups in other countries; for instance, joint research projects with those groups which have established programmes in robotics for harsh environment.

3. Research environment

Rating: 3

This RC is well established with the necessary facilities and has strong links with the industries, which has provided access to their facilities and opportunities for their research. It is a relatively large community with many members; however, the funding it has obtained is relatively low. In addition, their international collaborations are quite limited. With such strong local support and its unique environment, the community has a potential to grow and create a significant critical mass to attract much funding and establish international collaborations. They just need to develop a better research environment with a better focus on robotic solutions, which will consider mechatronic, energetic and environmental dimensions truly.

4. Potential of the Research Community

This research community aims to tackle a niche area and which has a great potential to support its local industries. With its strong local industry connections, extensive experience in heavy machineries necessary facilities and complementary skillsets, it has the potential to excel and become a national leading RC. However, it is essential for this community to have a clear and forward-looking plan to create a critical mass, build up its infrastructure, attract the necessary support and establish strategic partnerships.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 41%, which can be considered as good coverage. However, it seems that a majority of the research of the research community exists outside the coverage, so the bibliometric analyses should be considered very carefully. In FIRE research community, there were 24 researchers whose publications were included in the analyses. There were 60 articles, 0 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	60
TCS	54
MCS	0.9

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	0.18
MNJS	0.55
PP(top10%)	0%
PP(uncited)	63%
Proportion of self-citations	42%
PP(collab)	63%
PP(int collab)	40%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	18	1.33	24	0.2	0.56	0 %	44 %	43 %	94 %	78 %	42 %
2012	2	1.5	3	0.25	0.59	0 %	0 %	40 %	50 %	0 %	32 %
2013	22	1.09	24	0.23	0.46	0 %	64 %	33 %	45 %	23 %	39 %
2014	9	0	0	0	0.74	0 %	100 %	100 %	56 %	33 %	41 %
2015	9	0.33	3	0.18	0.53	0 %	78 %	25 %	56 %	22 %	47 %

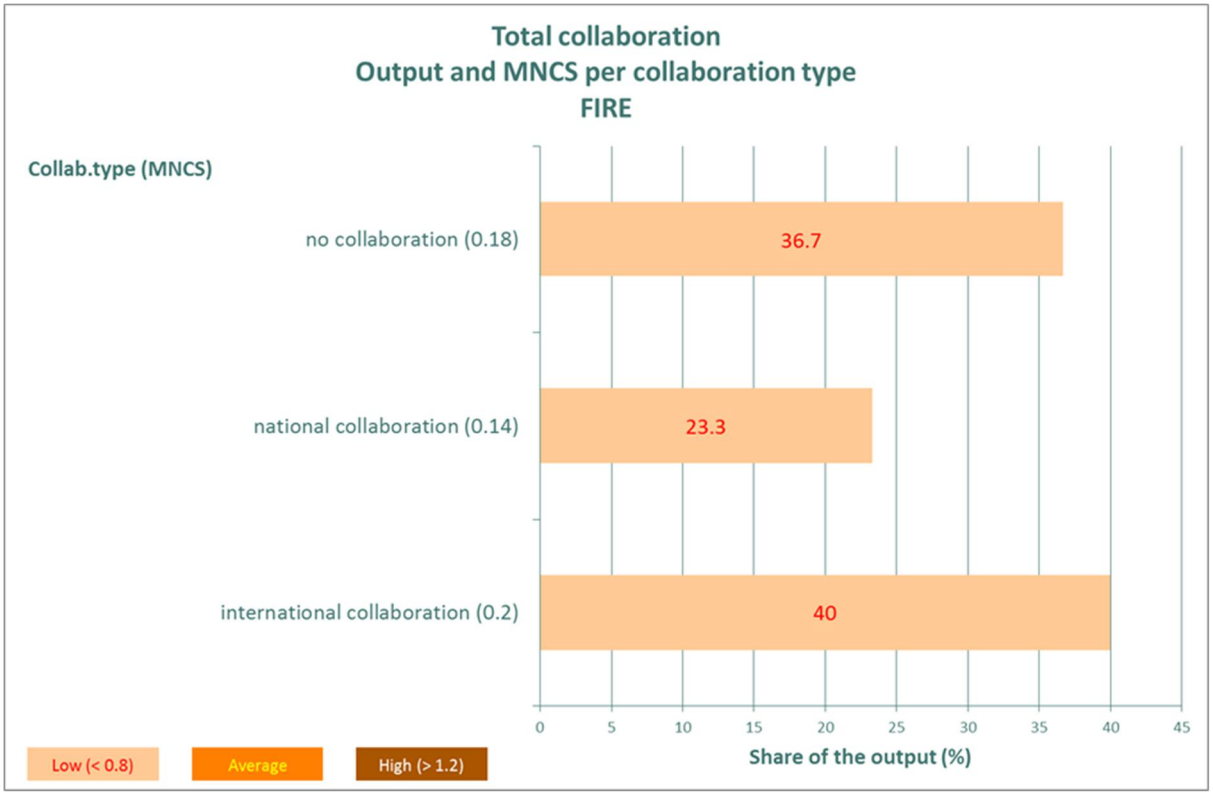


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage is 51%, which is considered as good coverage.

Table 4. Scopus indicators

Indicator	Performance
P	184
H-index	7
TCS	241
MCS	1.3
N-uncited	98
PP(uncited)	53%
Proportion of self-citations	50%

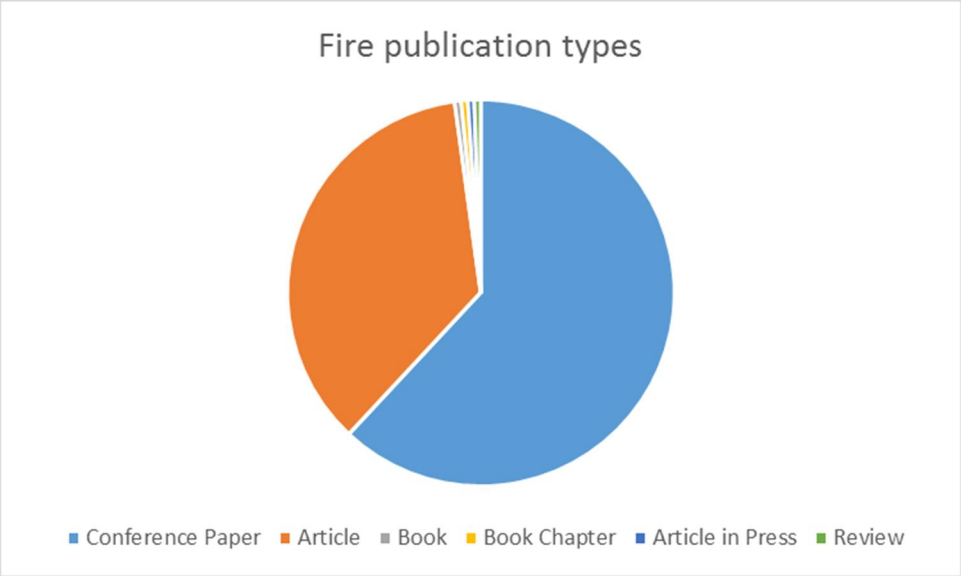
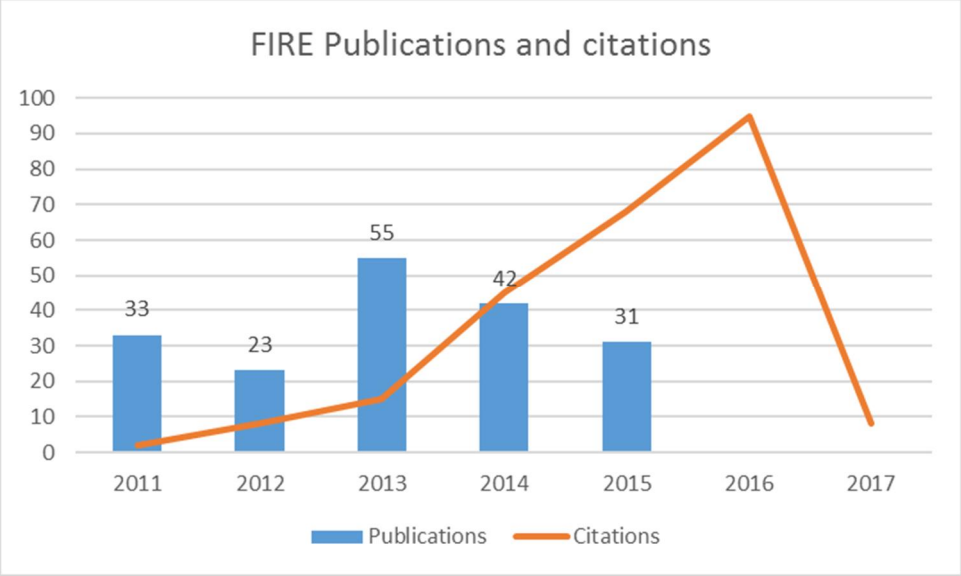


Figure 2. Publication types in Scopus dataset.



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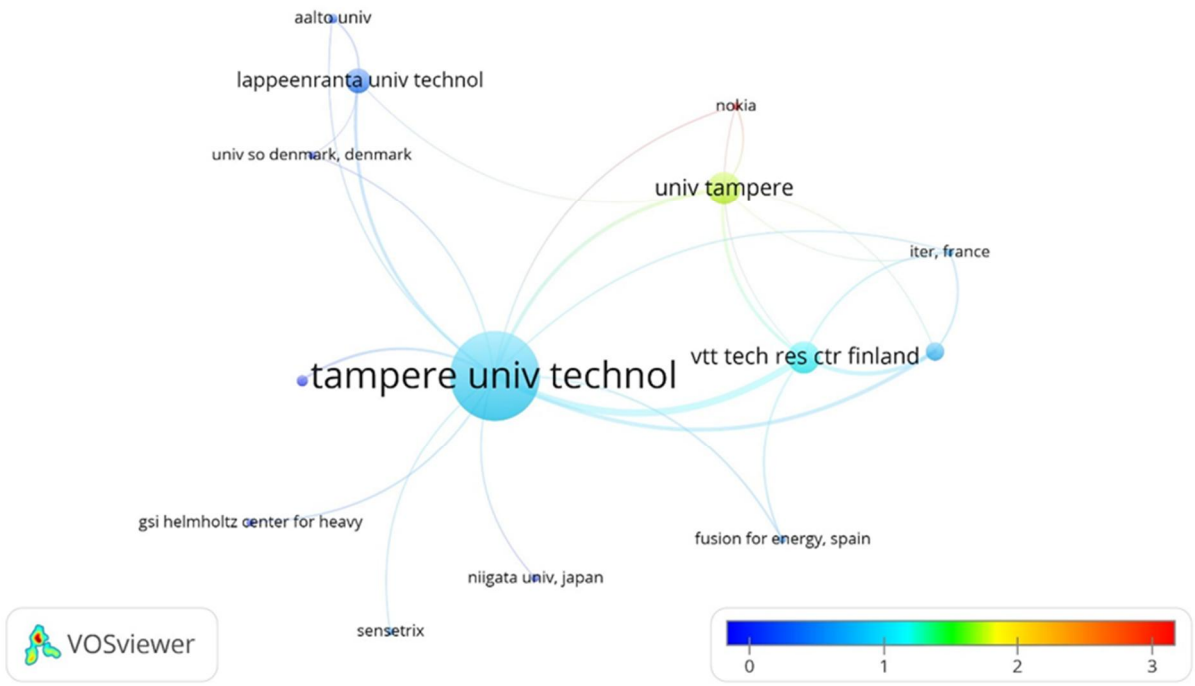

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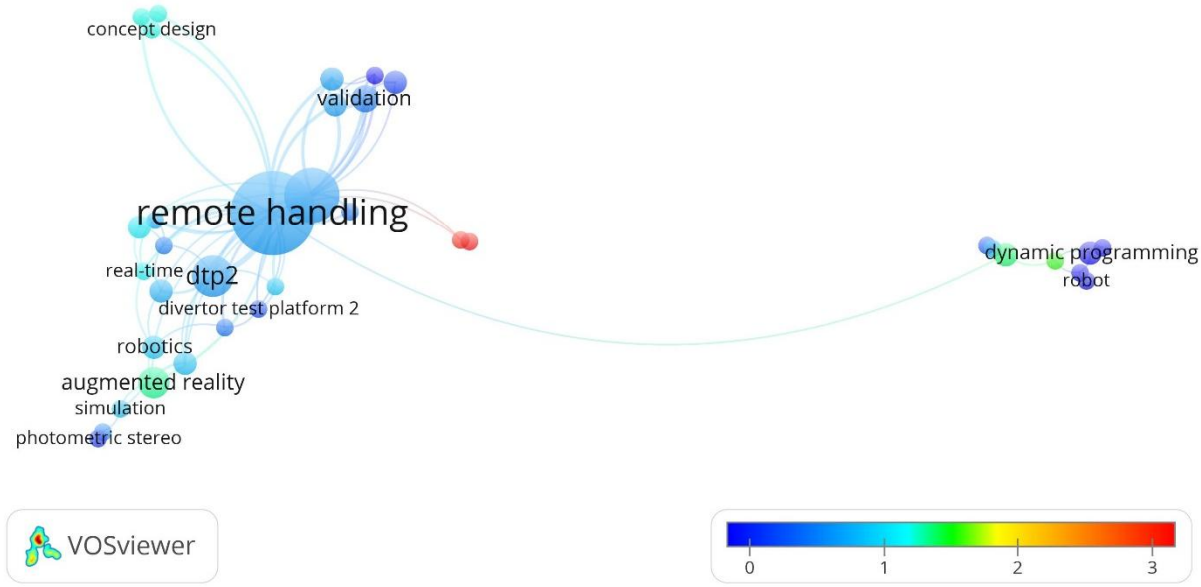

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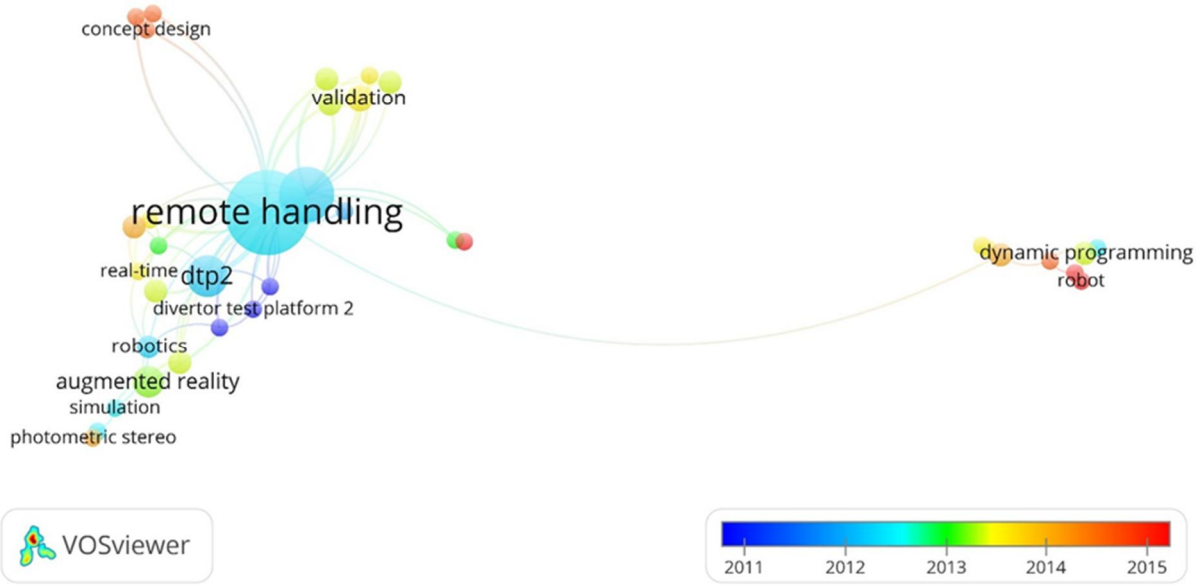

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10. Frontier Photonics

Head of Research Community: Mircea Guina

Abstract

The research community (RC) consists of ten research groups, which form the core of TUT's strategic profiling area "Light-Based Technologies". During 2017 the community will be further strengthened by two tenure-track faculty appointments. The overall ambition of the RC is to enable major advances in photonics science and technology by providing synergistic vision and multidisciplinary combination of resources. Our activities spread across the entire value chain from fundamental to applied research linked to industrial exploitation, unleashing the societal benefits of light-based technologies. On the fundamental side, we focus on new approaches for harnessing key properties of light fields, nanoscale photon management, and the development of advanced materials and nanostructures with tailored optical properties. On the applied side, we focus on developing novel light sources for quantum technology, sensing, and medicine, novel approaches for solar energy conversion, application-specific photonic integrated circuits, and new imaging and spectroscopic techniques.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 5

The research areas covered by the RC are areas of intense scientific effort and engineering development worldwide. The tools at their disposal (MBE, ALD, E-Beam and Nanoimprint Lithography, FIB, etc.) provide the RC with state-of-the-art capabilities. Of particular note are their research programs in photonic integrated circuits, multi-junction solar-cells, and high power semiconductor lasers, which require the capital equipment and facilities present at TUT, and which few universities have at their disposal.

Researchers in the Frontier Photonics community have consistently published original results as the primary authors in the highest impact journals in their respective fields. In general, these publications have dealt with important applications and have reported on novel uses of technology and new approaches, significantly advancing the field.

Of particular note and merit are their results reported on:

- Multi-junction solar cells, which are competitive with the leading groups world wide
- Hybrid integration of active devices into SOI platforms
- Demonstration of 1.2-1.3 um lasers on Ge substrate
- Trace detection of gases
- High power DBR lasers
- VCSEL based lasers at important wavelengths for spectroscopy.

The FP community has also made significant contributions by authoring review articles on a number of topics in very high impact journals, as well as the publication of theoretical papers covering the development of highly useful mathematical models of nonlinear processes in photonics.

Their efforts in biomedicine and other areas are good and novel, but represent more of an incremental contribution. Some of the areas of biomedicine which they have focused on have

been explored for several decades (photosensitized drug release, laser applications in cardio-vascular disease) and have not had a dramatic impact on the practice of medicine. The devices they have developed as photonics integrated circuits take advantage of the TUT fabrication capabilities but they have not demonstrated the ultimate utility in applications of these devices in photon enabled computing architectures. In both of these areas the RC could benefit by more extensive collaborations with research groups at TUT and elsewhere that are more directly involved with the applications.

2. Societal relevance of research

Rating: 5

The Frontier Photonics program recognizes that photonics technology plays a major role in many areas of great importance to society. They have focused much of their program activities on developing the technology to address problems in energy, medicine, information technology, environmental sensing, and security. This is a very laudable structure for their program.

Areas of high societal impact in the FP program:

- New high efficiency photovoltaic devices for energy generation
- Process monitoring of biomass
- Environmental monitoring of chemical and nuclear hazards

The FP community is well poised to expand their efforts in environmental monitoring through the use of spectroscopy techniques for measuring trace gases.

The programs in biomedicine would benefit from closer collaboration and interaction with medical groups at UTA that can identify specific applications in biomedicine with higher impact. For example, imaging methods that would provide better understanding of in vitro dynamics of stem cells in tissue engineering and regenerative medicine, minimally invasive optical methods for monitoring brain function, and incorporation of optical sensors into wearables.

3. Research environment

Rating: 5

The RC has access to state of the art facilities, which are comparable to those at major universities around the world. The RC principal investigators have identified important application areas that benefit from the unique capabilities of novel photonic devices which can be fabricated in the TUT facilities. The focus on important “practical problems” of great interest to society as well as basic science has created a vibrant and motivated research community. They have recruited student and postdocs from diverse backgrounds and have an adequate gender balance at this level, but could benefit from further recruitment of female researchers at the professor level.

4. Potential of the Research Community

The Frontier Photonics Research Community has made significant contributions to science and technology over the past decade. The faculty, students, and facilities at TUT provide an excellent platform to continue at this performance level. The identification and focus on areas of application of photonics with societal impact has created a highly motivated and energetic research community. Their development of new approaches to technology and measurements

in these areas has stimulated new analytical techniques, which has accelerated progress in the science of photonics.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 91%, which can be considered as excellent coverage, and the bibliometric analysis is reliable. In Frontier Photonics research community, there were 53 researchers whose publications were included in the analyses. There were 641 articles, 21 reviews and 4 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	**Performance**
P	663
TCS	4853.5
MCS	7.32

Table 2. Normalized Web of Science indicators

Indicator	**Performance**
MNCS	1.18
MNJS	1.25
PP(top10%)	12%
PP(uncited)	21%
Proportion of self-citations	30%
PP(collab)	81%
PP(int collab)	57%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	150.5	8.56	1288.5	0.85	1.05	9 %	19 %	36 %	76 %	45 %	91 %
2012	126.25	14.4	1818	1.69	1.5	20 %	14 %	25 %	80 %	59 %	92 %
2013	134	6.69	896	1.06	1.11	7 %	19 %	29 %	79 %	54 %	90 %
2014	137	4.48	614	1.29	1.45	14 %	22 %	30 %	85 %	63 %	92 %
2015	115.25	2.06	237	1.08	1.18	10 %	33 %	34 %	88 %	65 %	91 %

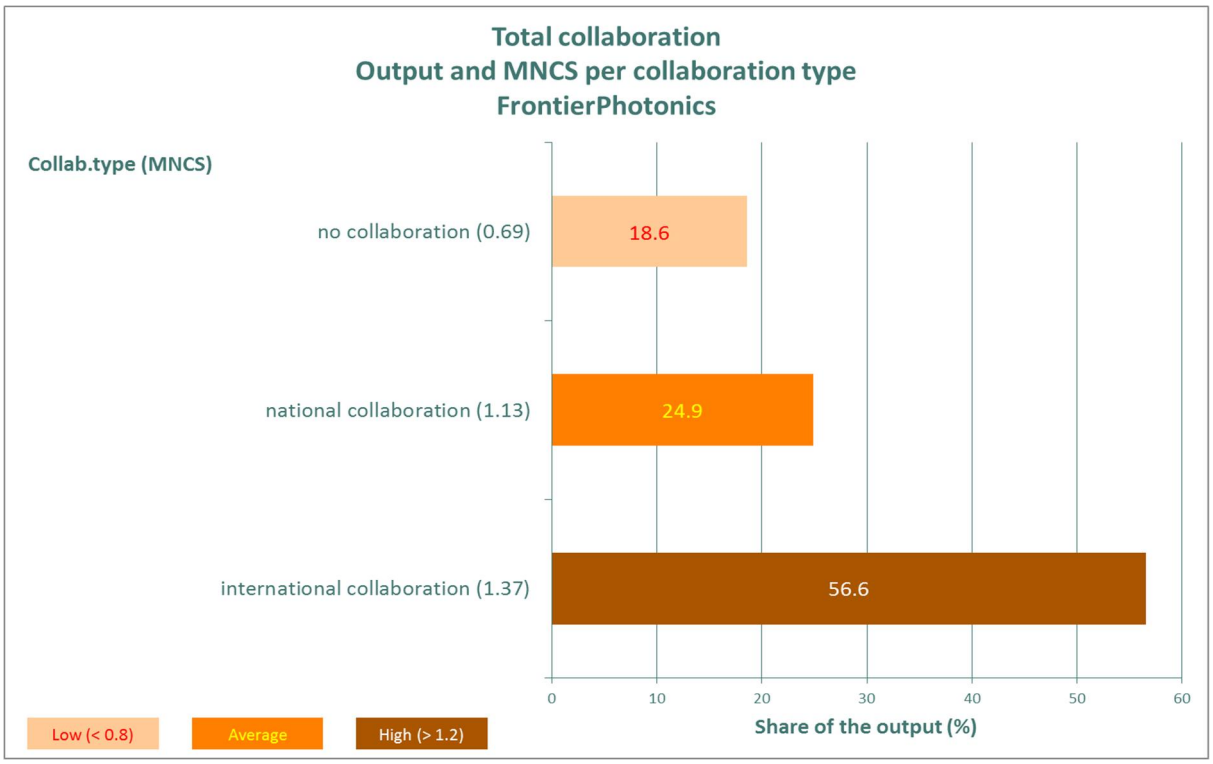


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of the research community is 85%, which is considered as excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	1010
H-index	34
TCS	6029
MCS	6.0
N-uncited	414
PP(uncited)	41%
Proportion of self-citations	31%

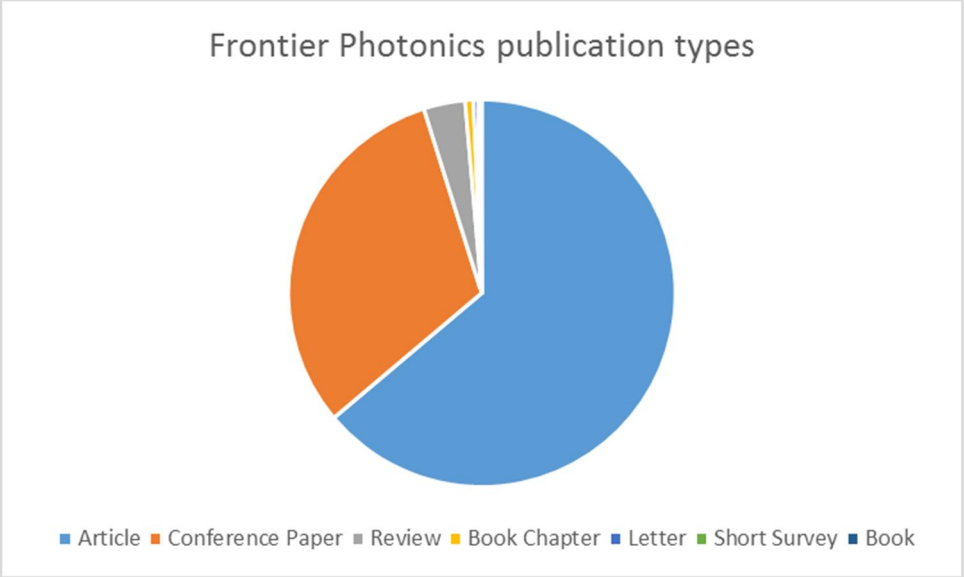


Figure 2. Publication types in Scopus dataset.

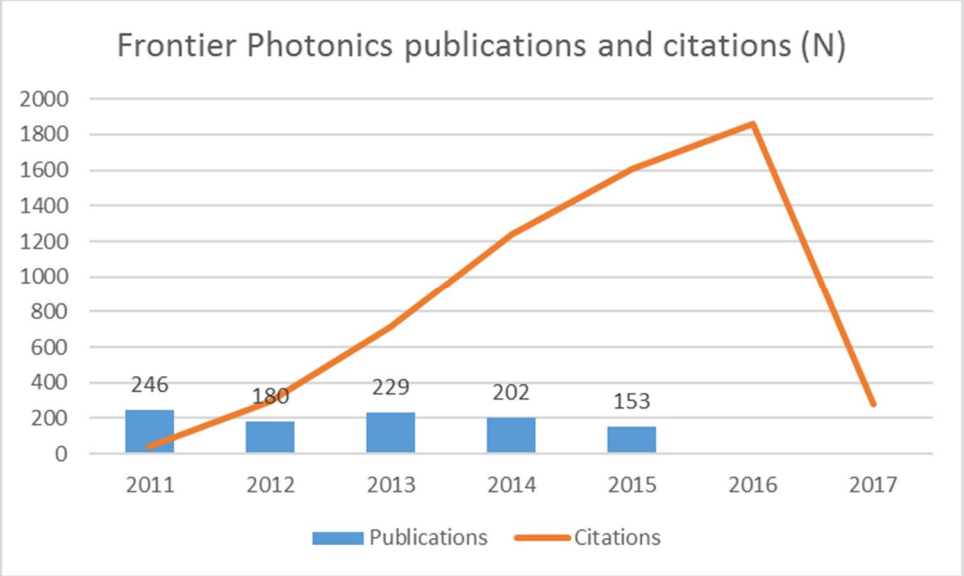


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

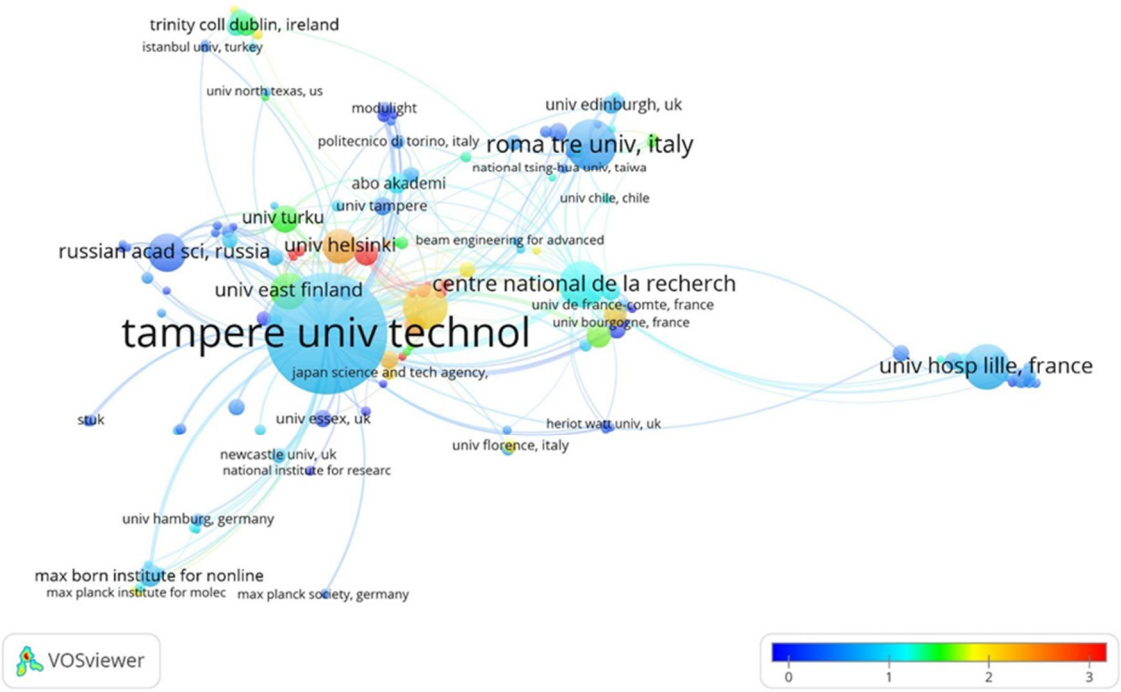


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

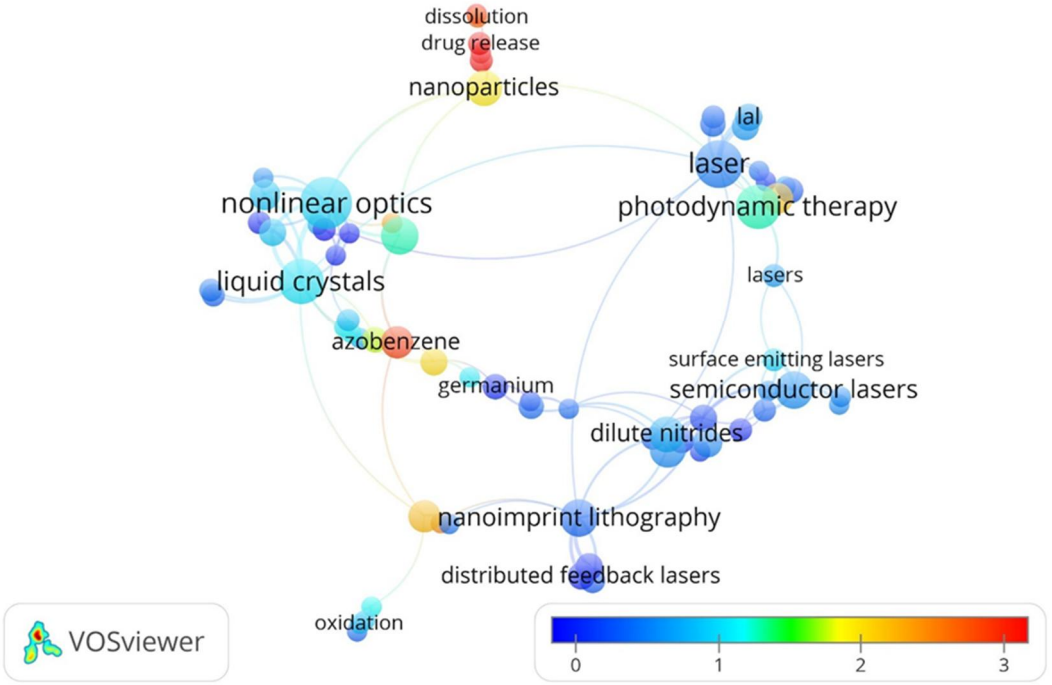


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

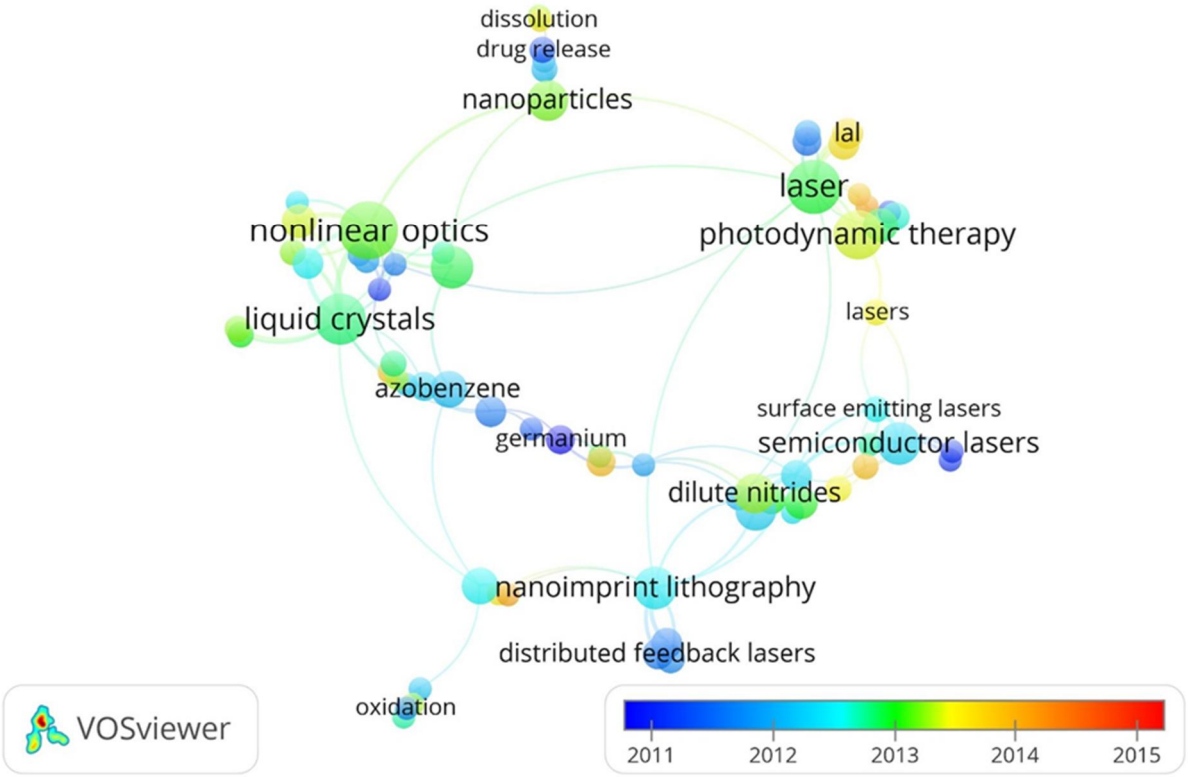


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

11. Integrated Technologies for Tissue Engineering Research (ITTE)

Head of Research Community: Minna Kellomäki

Abstract

The motivation of forming the Research Community in Integrated Technologies for Tissue Engineering comes from the fact that in tissue engineering, tissue repair and diagnosis several disciplines of science and research are needed. Thus, our RC is composed of cell biologists, engineers and clinicians and it aims to study and develop new tools and methods that will produce novel TE based products. More specifically, we will produce knowledge and innovations in biosensors, biomaterials, microfluidics, micro and soft robotics, measurement and imaging systems, image/signal analysis technologies and mathematical models of human cells and tissues. With the help of these technologies, we aim i) to gain better understanding on differentiation and functionality of human stem cells and their derivatives, ii) to understand how tissue development and maturation is controlled by electromechanical and chemical stimulus in humans and iii) to learn how specific disease pathologies proceed and cause the clinical phenotype. The RC teams have already several years' of collaboration experience. We have created common practices and scientific language in the previous common projects and the groups have premises close to each other and joint laboratories. When comparing our research environment to other tissue engineering research environments in Finland, there is no other such a tight and diverse research community that combines engineering, stem cell biology and medicine as our RC. Even globally, the closeness and tightness of the joint research activities is unique compared to the seemingly similar organizations in the world. Thus, we believe that this continues to benefit us to compete and be successful in an international scale.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

This is the RC in the field of tissue engineering with a consolidated reputation in Europe and worldwide. The group combines material engineering, molecular and cell biologists and clinicians who have shown to be fully integrated in highly productive research. The track record is outstanding with a large number of breakthrough papers published in journals of relatively high impact factors. The researchers work on traditional biomaterials, but the engineering solutions for materials, materials/cell constructs and organ-on-chips based on microfluidics are to the forefront of research. Throughout the last decade, the ambition of the team has been growing in line with the most advanced and widely-recognized research priorities always maintaining a distinct research output and more recently achieving the objective of validating some of their technology at clinical level; a notoriously difficult stage in such a challenging field. The research group has also been expanding its activity to a very important field of research: the development of organ-on-chips that can revolutionize drug development testing and pave the way to the understanding of pathological processes.

2. Societal relevance of research

Rating: 5

Through pioneering and advanced tissue engineering solutions, the team has validated with robust science and clinical studies tissue engineering treatments in several areas of application. Although the team may not have yet fully exploited the intellectual properties, their

research can be considered as one of the most advanced ones worldwide and with a technology readiness level closer to exploitation than most of the work currently in progress in Europe.

3. Research environment

Rating: 4 to 5

The investment received from the University has put this group in the position of having a world-leading role, both in terms of highly qualified personnel and facilities. This has been matched by the ability of the team leaders to attract substantial funding, provide high standard training and have available an Advanced Therapy Medicinal Products (ATMP) facilities. The networking with prestigious international organization worldwide is impressive and strategically very well thought.

4. Potential of the Research Community

In case of positive outcomes, the whole worldwide community would benefit from the outcome of the clinical studies currently in progress and would make ITTE regarded as a world-leading team capable of paving the way to new pioneering translational research. The international reputation can also be strengthened in the coming years with a more visible and coordinated presence of all the main players and early career researchers at international conferences. The RC should pursue closer collaborations with EMASS to pursue innovative surface functionalisation of biomaterials and with Frontier Photonics in respect to imaging research. The group could improve their international presence and impact by integrating clinical fellows in their team.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 90%, which can be considered as excellent. In the research community, there were 55 researchers whose publications were included in the analyses. There were 520 articles, 13 reviews and 2 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	553.5
TCS	4813.25
MCS	9.02

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.29
MNJS	1.18
PP(top10%)	11%
PP(uncited)	14%
Proportion of self-citations	20%
PP(collab)	90%
PP(int collab)	41%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	90	14.44	1300	1.05	0.98	13 %	6 %	19 %	87 %	23 %	90 %
2012	91.25	17.1	1560.25	1.57	1.25	11 %	5 %	16 %	89 %	25 %	89 %
2013	104	7.85	816	1.05	1.14	9 %	7 %	25 %	92 %	44 %	91 %
2014	119	6.14	731	1.33	1.21	13 %	16 %	21 %	91 %	51 %	90 %
2015	129.25	3.14	406	1.43	1.28	10 %	29 %	23 %	89 %	52 %	90 %

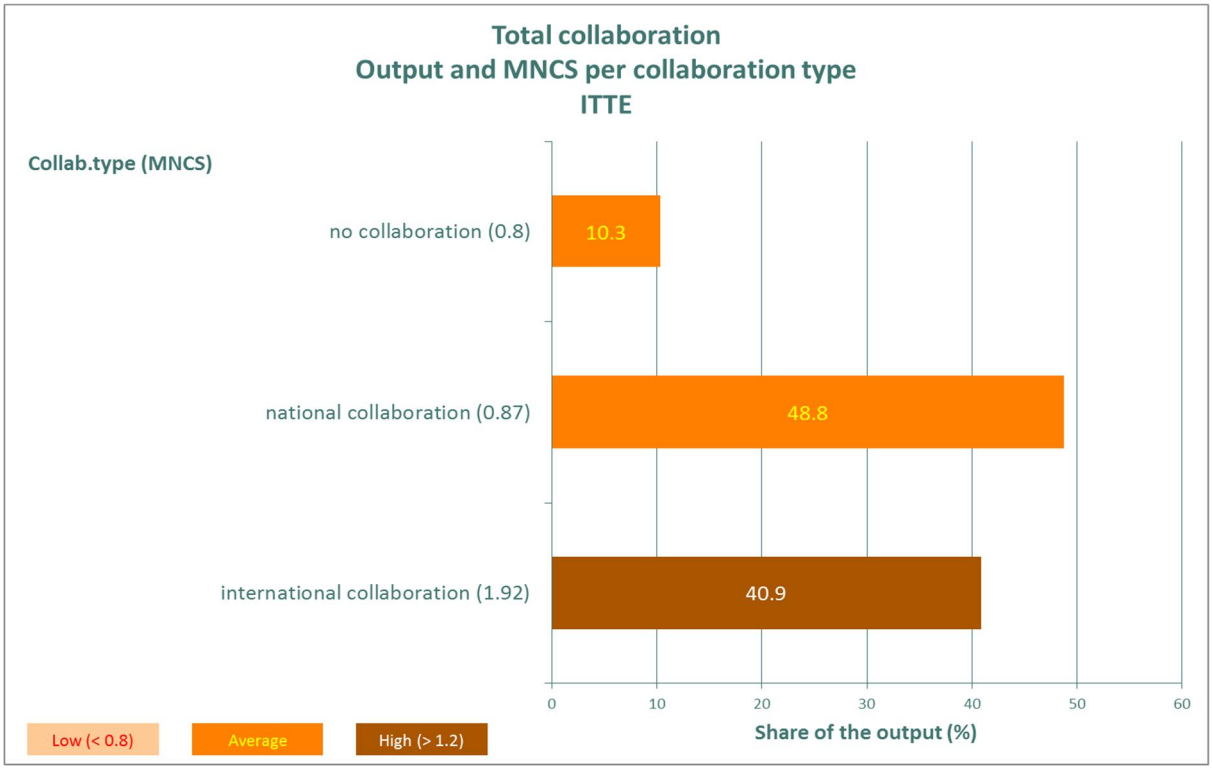


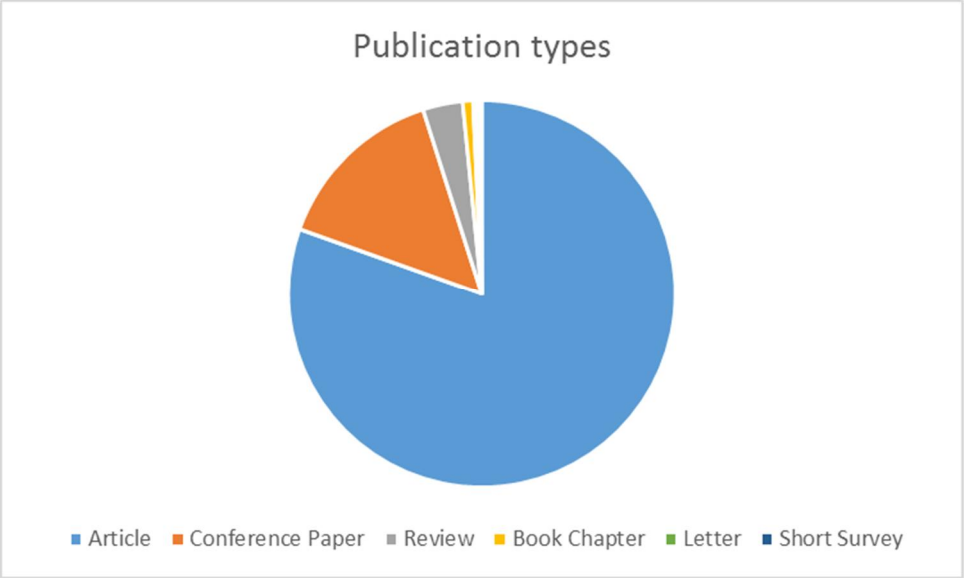
Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 90%, which is considered as excellent.

Table 4. Scopus indicators

Indicator	**Performance**
P	691
H-index	29
TCS	5044
MCS	7.3
N-uncited	153
PP(uncited)	22%
Proportion of self-citations	22%



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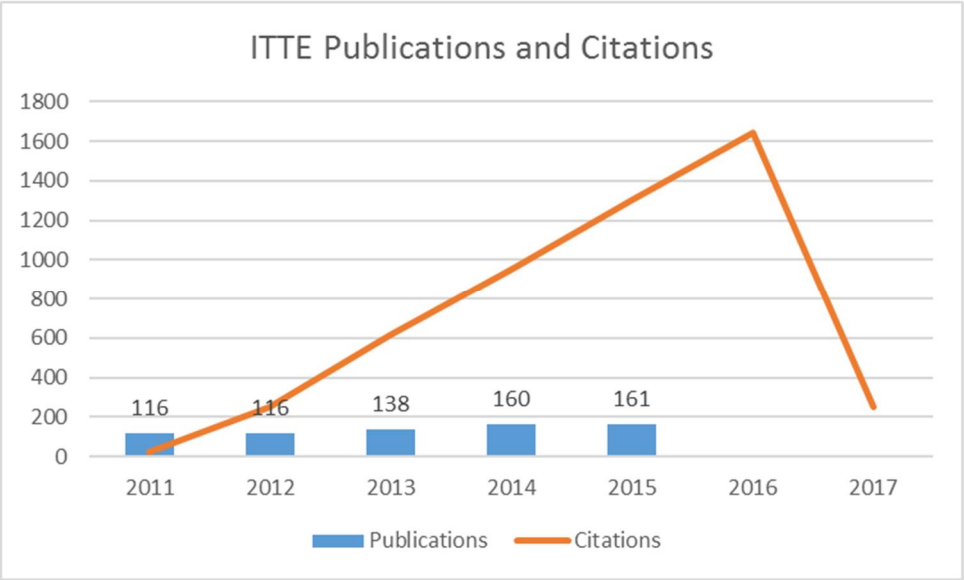

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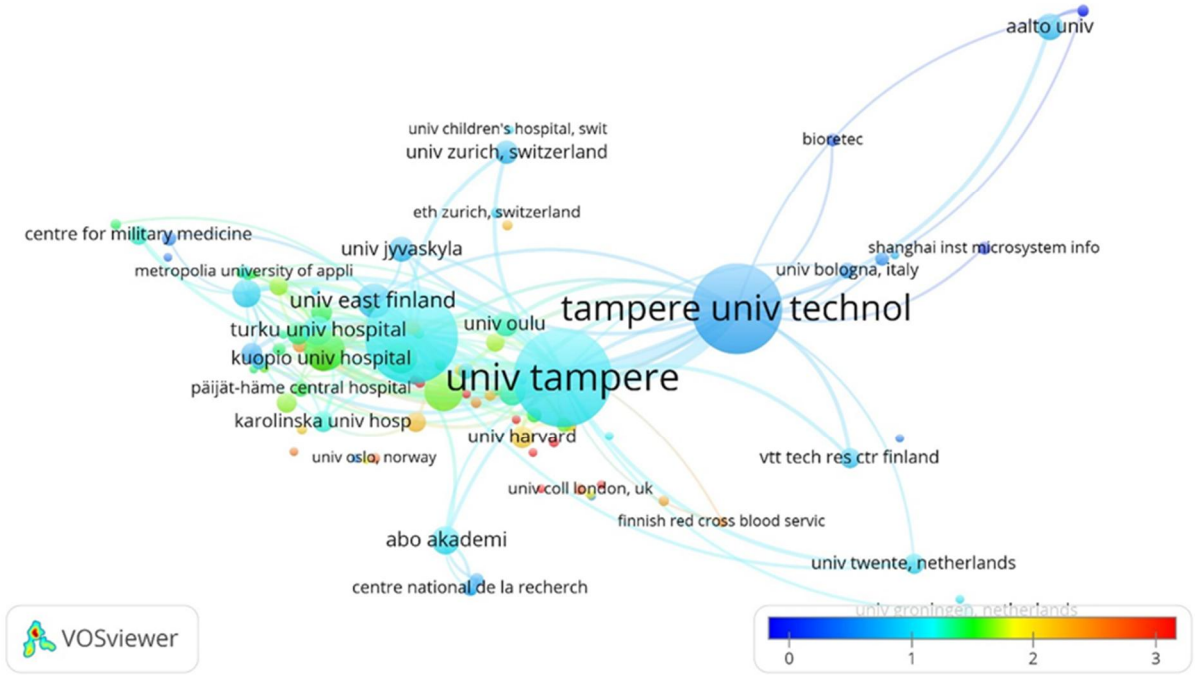

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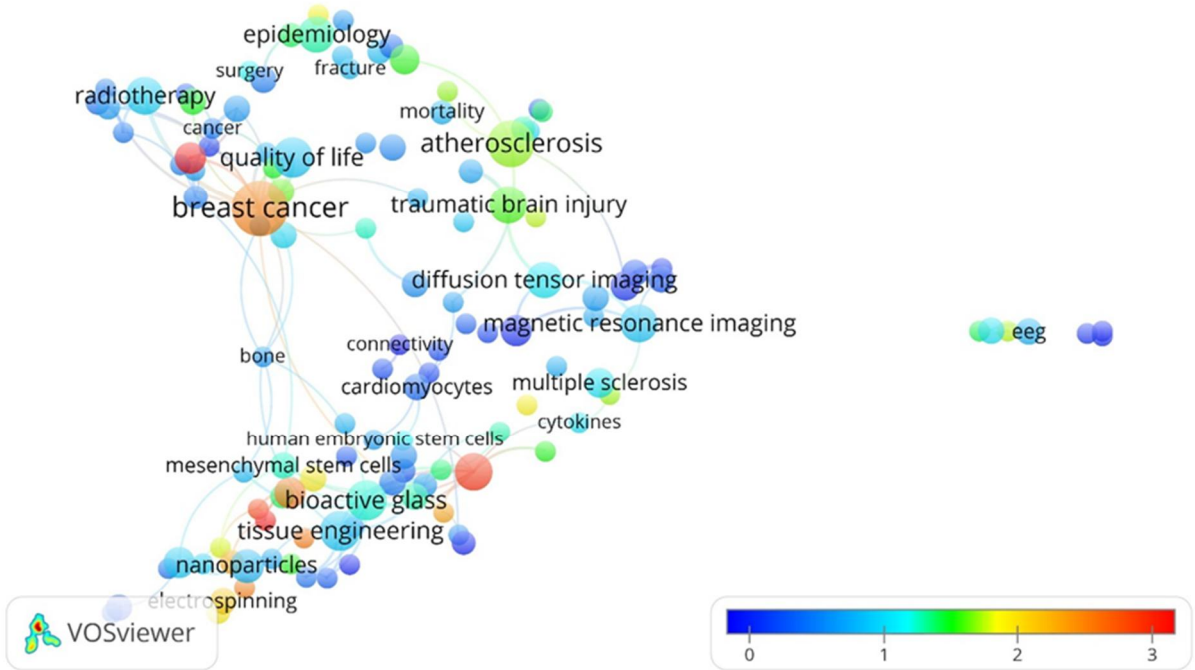

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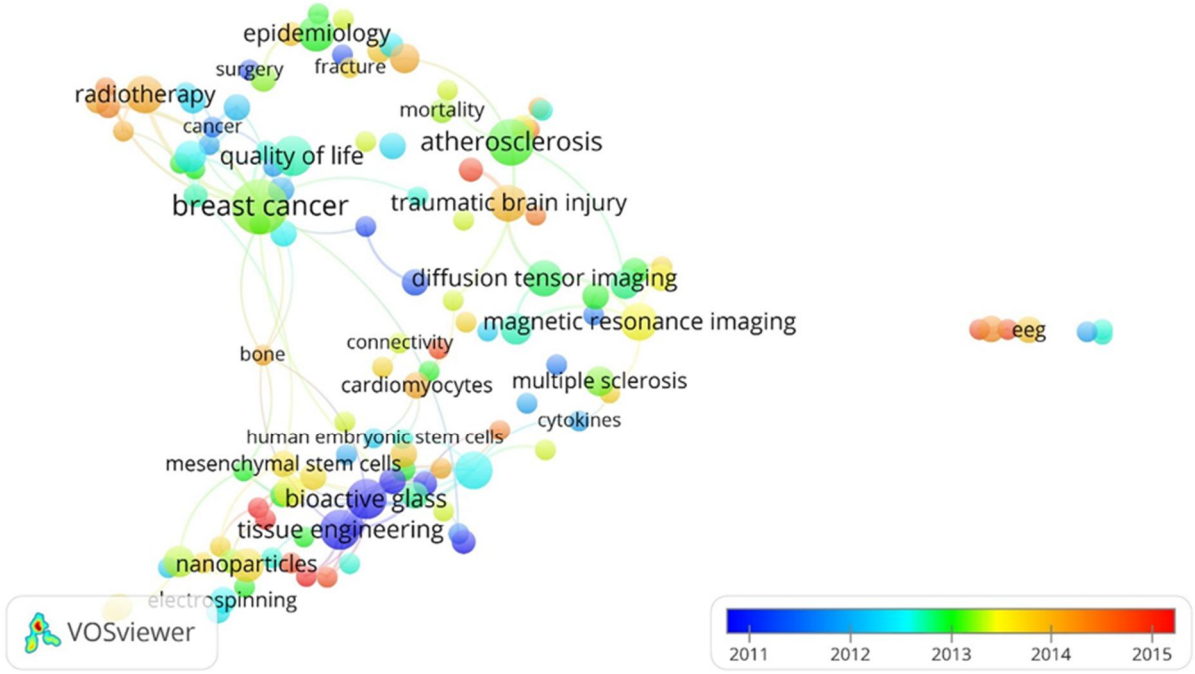

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12. Life Cycle Effectiveness of the Built Environment (LCE@BE)

Head of Research Community: Kalle Kähkönen

Abstract

The built environment is a key enabler for functioning of societies in economic and social terms, security, quality of life and overall competiveness (ECTP, 2005). The role of the built environment (BE) in our society is of fundamental importance, since as a whole it comprises over 70% of our national wealth (RT, 2016). The LCE@BE research community studying the Life-cycle effectiveness of the built environment system includes experts of TUT and other cooperating organizations. The LCE@BE research community's mission is to be an important enabler of systemic change in the real estate and construction sector. Often the systemic solutions are as strong as their weakest link since, for example structural failures, water safety and decayed townscape can cause long lasting problems. The regulatory framework and related public and private decision making at different levels have created a complex sphere where a variety of agendas, their objectives and priorities are blurring the overall picture and targeted harmonised results can be very difficult to reach. The present problems are multidimensional and very tricky requiring new research based breakthroughs and innovations. The LCE@BE aims towards such solutions and their societal implications in the built environment with its research.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 2

The real estate and construction industry represents in many countries the largest industry, and in Finland the built environment represents more than 70% of the national wealth. This group clearly does solid applied research in civil engineering that is well-focused on building performance and transportation infrastructure, with outcomes that are very important in the Finnish context.

However, the built environment sector also represents one of the most important areas for reducing energy consumption and potential for achieving sustainable development. The cradle-to-grave (fuel/materials resource extraction, materials processing, construction, use, end-of-life) environmental impacts of the built environment are a major proportion of our environmental footprint, but are not adequately addressed in past work as well as in the RC research plan. For example, the research plan mentions adaptation in response to climate change, but does not seem to include prevention of climate change (and it should be noted that serious environmental impacts of the built environment are not limited to climate change). The RC presents a very ambitious aim with a systems-oriented approach to life cycle effectiveness of the built environment, and describe 3 main research areas, where each is split into 3 research goals. Altogether, this creates 9 research goals connected to ongoing projects and / or new project initiatives. These 9 goals/projects are described in detail under the list of top 10 achievements of the RC. The broad approach, and the numerous fields of expertise included, has resulted in a large size research community (18 professors at TUT, and a total of approximately 150 personnel, including 96 PhD students). Although the broad approach and the research framework may be relevant and an interesting approach, it is difficult to see how this large research community can together can address the overall goal for the RC and achieve a high international level for the scientific work in all areas.

The three areas/goals of the research plan (high performance buildings and structures, intelligent asset management of transport infrastructure, management of transitions in the built environment system) are relevant and appropriate, but neither the documentation nor the presentation/interview sufficiently clarified the approaches that can or will be used to address them.

The RC briefly mentioned optimization and modelling studies without convincing details and did not consider two significant components, namely materials resources and energy flows. Management of transitions seems to be a non-technical direction that is not clearly related to the experience of the team members.

The productivity of high quality publications and citations show a good growth since 2011 (publications increased by a factor of 3) but are still low compared to leading international research groups. The panel appreciated that the RC has contributed conscientiously to standards development with a good national and international impact.

2. Societal relevance of research

Rating: 3

Societal relevance of past work has been mainly expressed through projects that are important in the Finnish context and standards development. Research in the planned three areas (high performance buildings, intelligent asset management of transport infrastructure and management of transitions in the built environment) has relevance to society at large, but the directly affected user communities have been fairly narrowly defined.

3. Research environment

Rating: 3

The laboratory facilities are well-appointed and managed for conventional civil engineering testing. The research community was presented coherently and seems to be well-integrated, but is missing multidisciplinary connections (for example, environmental and social sciences) and the RC international network could be improved.

4. Potential of the Research Community

The LCE@BE's mission is to be an important enabler of systemic change in the real estate and construction sector based on a comprehensive and broad framework for the RC. The main research question for the RC is: "What key knowledge and innovations can best serve society to build, operate and maintain a safe, user-oriented and ecological built environment?". Although the RC present well-defined research projects, it is difficult to see how their knowledge base can create such an ambitious total system for the built environment. There is a need to align the focus areas and strategic objectives with the stated research question. For international impact, the RC is recommended to increase its emphasis on publication of high quality journal papers.

The potential of this RC to address its research question would be significantly improved by increased focus on / recruitment of experts in modelling and simulations (BIM/VR/4D modelling etc.) in relation to building performance, sustainable construction and/or assessment of life cycle (cradle-to-grave/cradle-to-cradle) environmental impacts.

Active co-operation with others or recruitment of personnel with background from humanities and social science would strengthen the cross- and multidisciplinary approach to several of the research areas and projects. This also relates to the real estate and construction industry change management where collaboration or recruitment of researchers from project management, economics and business administration will increase the potential of the RC.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 45%, which can be considered as good. However, more than half of the references appear outside the coverage. Therefore, the bibliometric analyses should be considered very carefully. In the research community, there were 49 researchers whose publications were included in the analyses. There were 71 articles, 1 review and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	**Performance**
P	72
TCS	243
MCS	3.38

Table 2. Normalized Web of Science indicators

Indicator	**Performance**
MNCS	0.88
MNJS	1.02
PP(top10%)	5%
PP(uncited)	25%
Proportion of self-citations	22%
PP(collab)	49%
PP(int collab)	25%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	6	14	84	1.61	1.2	19 %	17 %	16 %	50 %	33 %	52 %
2012	12	4.33	52	0.78	1.06	8 %	8 %	17 %	42 %	33 %	50 %
2013	13	3.38	44	0.75	1.04	0 %	23 %	24 %	46 %	23 %	47 %
2014	18	2.17	39	0.9	1.01	0 %	22 %	19 %	39 %	17 %	48 %
2015	23	1.04	24	0.81	0.96	5 %	39 %	44 %	61 %	26 %	38 %

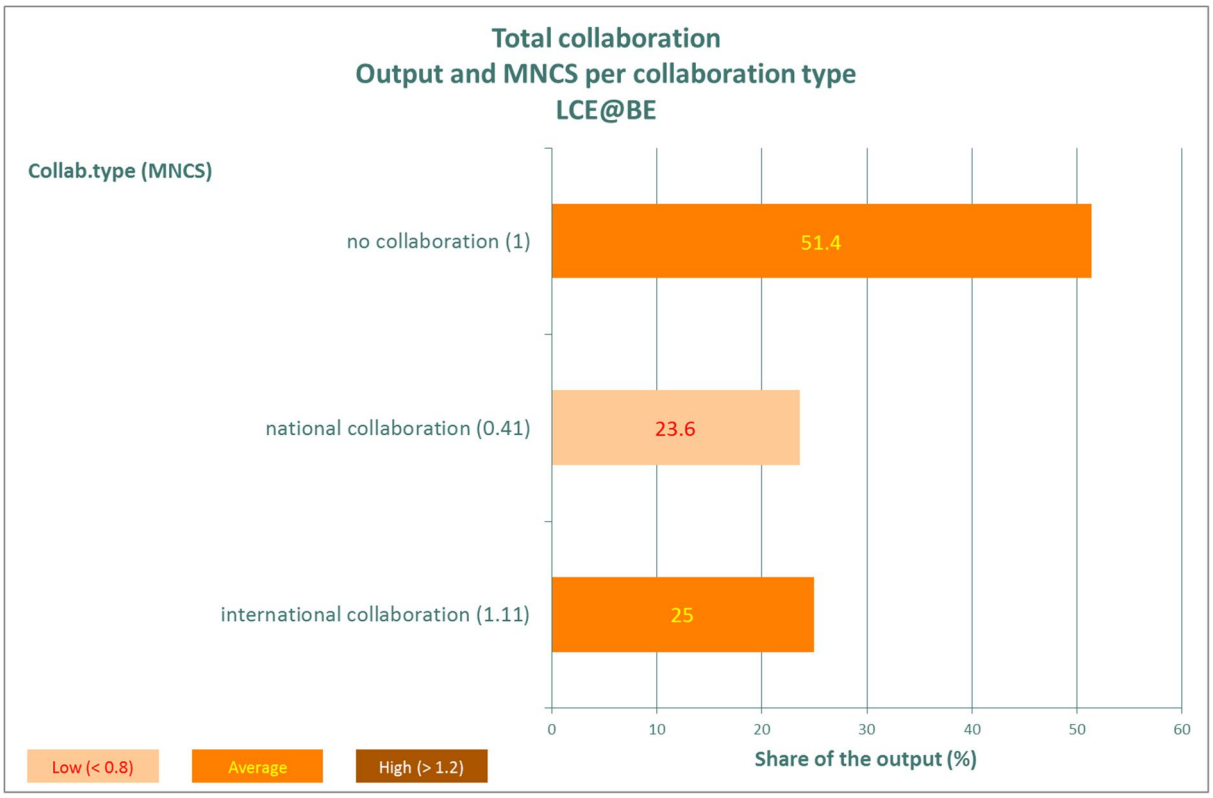


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 39%, which is considered as moderate coverage. Over 60% of the references are outside the coverage. Therefore, the bibliometric analyses should be considered very carefully.

Table 4. Scopus indicators

Indicator	**Performance**
P	161
H-index	10
TCS	462
MCS	2.9
N-uncited	72
PP(uncited)	44.7%%
Proportion of self-citations	24%

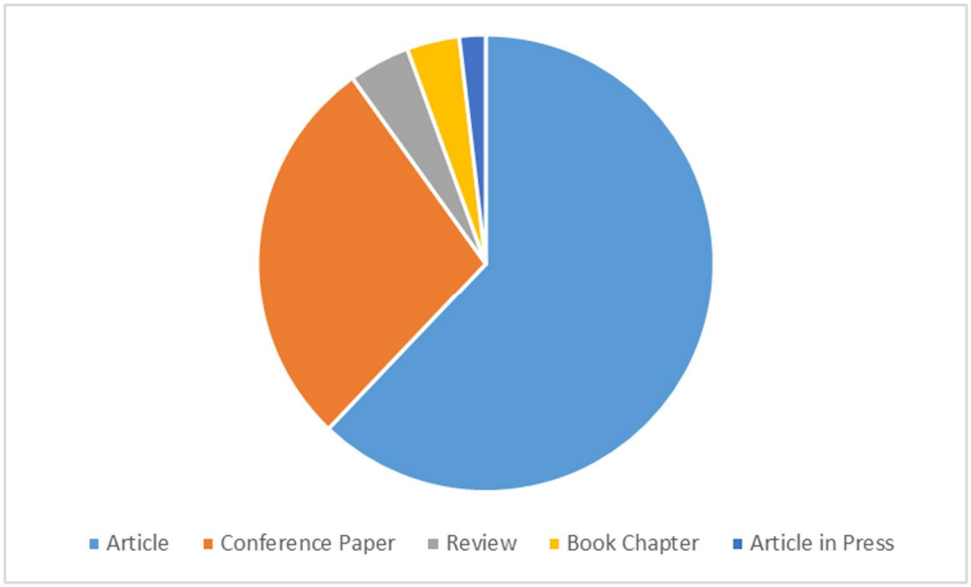
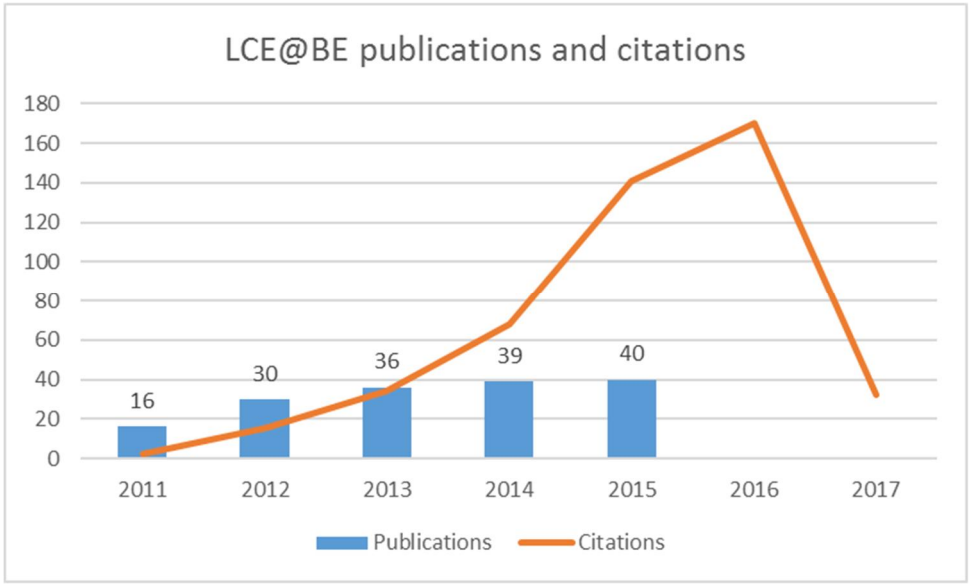


Figure 2. Publication types in Scopus dataset.



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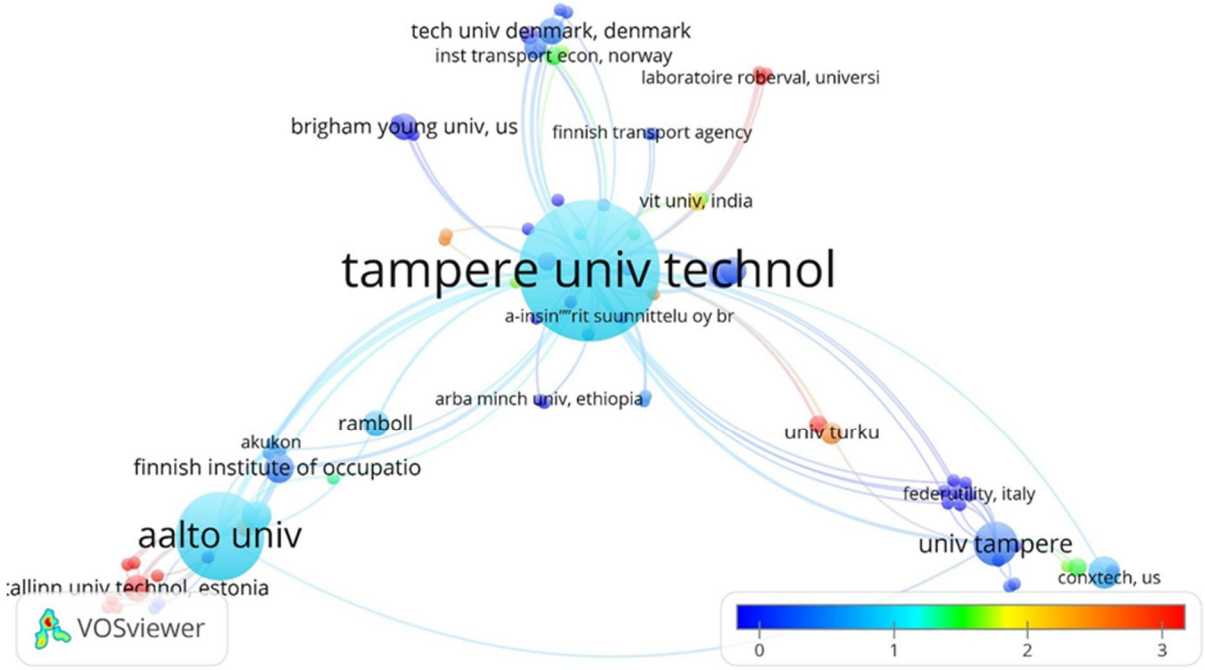

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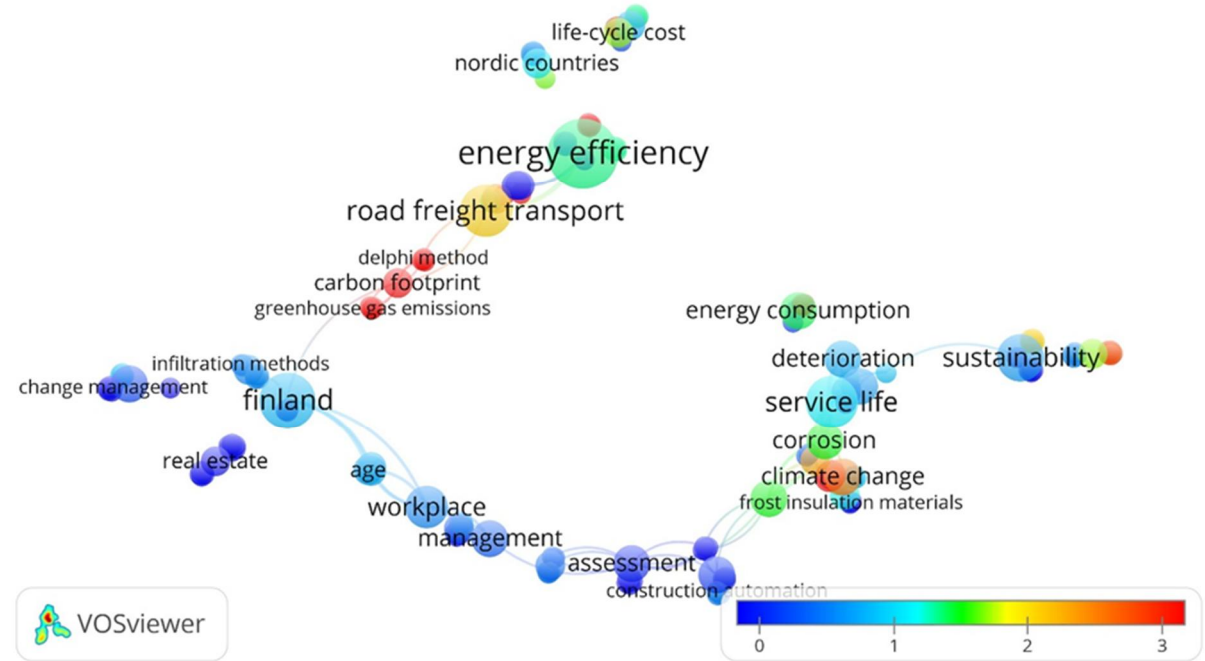


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

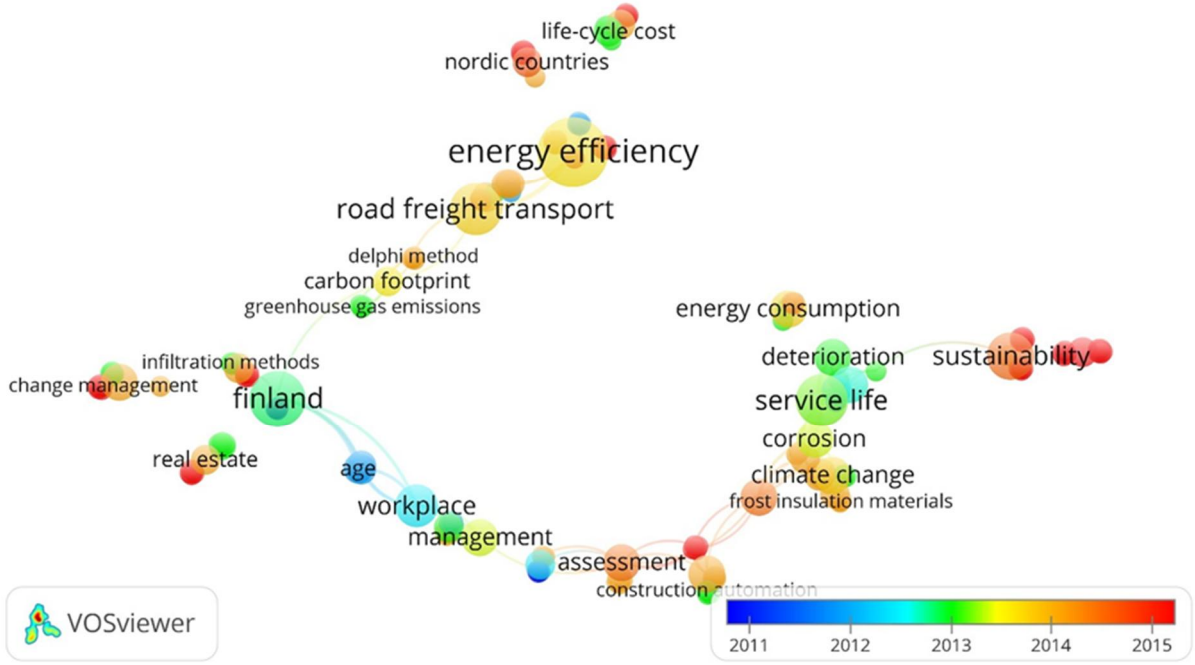


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

13. Managing digital industrial transformation (mDIT)

Head of Research Community: Samuli Pekkola

Abstract

Digitalization is the most influential and disruptive technological and societal change for 50 years. This large RC builds and implements a research agenda on digital industrial transformation for next generation value creation by combining three fields of research (industrial management, information and knowledge management, and software product and systems development). Digital industrial transformation implies changes and requires research in three domains: practices, models and tools for ecosystems; operations for novel ICT-based networks; and the dynamics of business ecosystems. The transformation is studied on three dimensions: 1) single-company vs. networked ecosystems; 2) innovations and value creation vs. optimization and control, and 3) tools and processes vs. platforms and frameworks. In particular, we will 1) build competences through cross-disciplinary shared agenda of conceptual and field research with companies; 2) educate next generation researchers able to utilize digitalization as an enabler for industrial transformation, and 3) reach high societal impact by solving and studying digitalization issues with real organizations.

Panel report

1. **Scientific quality and impact**
   Rating: 3

The panel observes the following:

- The RC addresses a very important phenomenon currently taking place in industry.
- The emphasis on value creation in networks and platforms for achieving successful digital transformation is a valid and promising focus.
- The topic is highly relevant and invaluable for an industrial engineering RC at a technical university.
- The RC has to invest more efforts in positioning themselves in building a unique international reputation and visibility. The RC currently has a broad multi-disciplinary and mixed-method approach. This is to be commended but combined with a lack of focus on industry sectors there is a risk that the variety of topics and cases is too broad to build a clear profile

2. **Societal relevance of research**
   Rating: 3 to 4

The panel is of the opinion that:

- The research is potentially of very high relevance. Nationally and internationally, both SME's and large companies are faced with the challenge of pursuing digital transformation. Not only internally, but also within their value networks. Conducting research and building knowledge in this area is clearly of great importance to large number of companies in every business sector
- National funding is significant but the RC has not succeeded yet in getting substantial international funding
- Strong aspects are the industry relations and ways of working with industry. The RC has ambitions to increase its impact to world class.
- The RC needs to build methods and tools to analyze value networks, ongoing digital transformation, and adapt or develop methods and tools for supporting digital

transformation. It is currently unclear what deliverables will be produced in the coming 5 years

3. The consortium and research environment

Rating: 3 to 4

The group consists of a coherent and balanced set of individuals. Good number of industrial partners and PhDs.

The mutual respect and complementary skills of the various disciplines in the RC is a strong asset.

4. Potential of the research community

The group is positioned in an important research area with high societal relevance and research potential. However, the current focus in methods, tools, industry sectors (seems to be ICT, Energy and manufacturing) is quite broad. This can be feasible if a comprehensive approach can be developed or a clear positioning that can be communicated to the outside world. This is currently absent.

While the national volume and quality of research is ample, there is potential for more international collaboration and funding.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 54%, which can be considered as good coverage. However, almost half of the references exists outside the database. Therefore, the bibliometric analyses should be considered very carefully. In the research community, there were 26 researchers whose publications were included in the analyses. There were 65 articles, 2 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	65
TCS	342
MCS	5.26

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.4
MNJS	1.15
PP(top10%)	18%
PP(uncited)	22%
Proportion of self-citations	15%
PP(collab)	43%
PP(int collab)	15%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	12	7	84	1.02	1.09	8 %	8 %	16 %	33 %	17 %	52 %
2012	6	17.17	103	3.15	1.16	48 %	17 %	11 %	0 %	0 %	51 %
2013	10	4.8	48	1.1	1.08	10 %	20 %	14 %	50 %	20 %	56 %
2014	26	3.58	93	1.36	1.26	18 %	12 %	17 %	50 %	19 %	58 %
2015	11	1.27	14	1.23	1.01	20 %	64 %	18 %	55 %	9 %	46 %

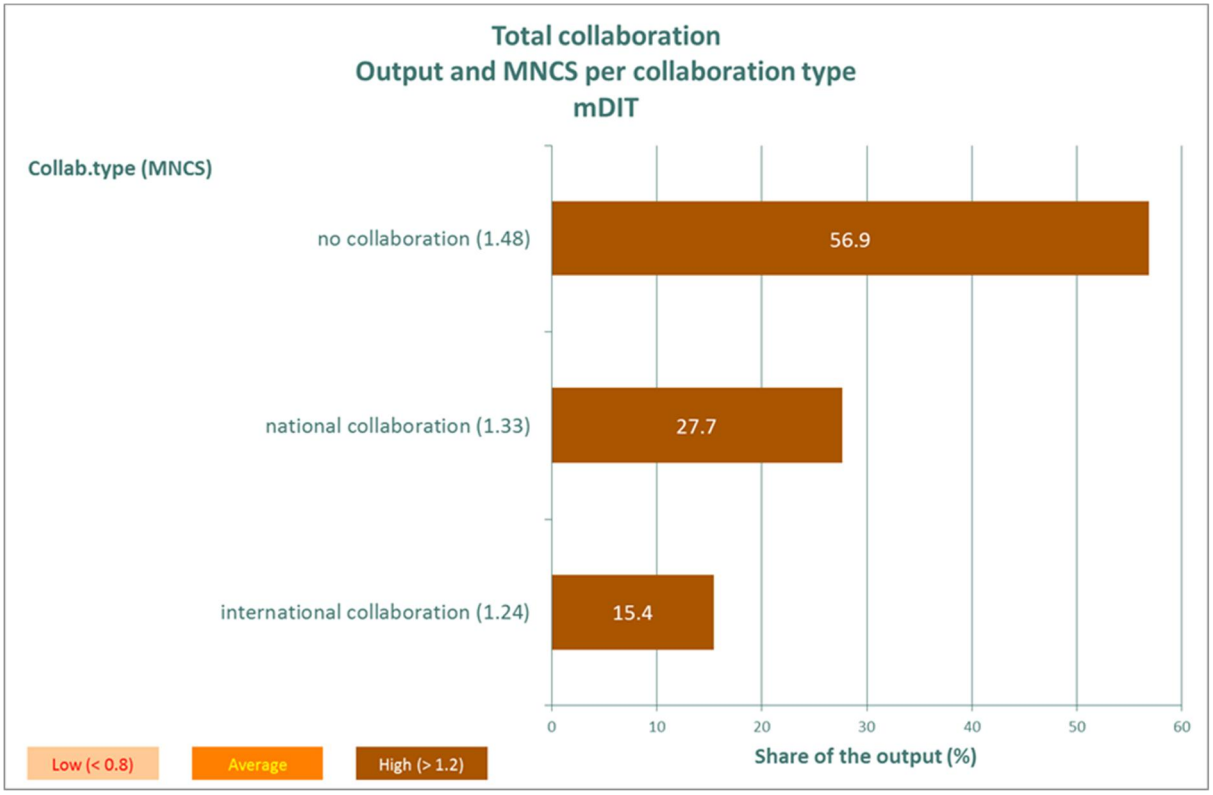


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of the research community is 54%, which is considered as good coverage. However, a great share of publications in the field appear outside the Scopus database. Therefore, the bibliometric analyses should be considered very carefully.

Table 4. Scopus indicators

Indicator	Performance
P	230
H-index	14
TCS	800
MCS	3.5
N-uncited	107
PP(uncited)	47%
Proportion of self-citations	21%

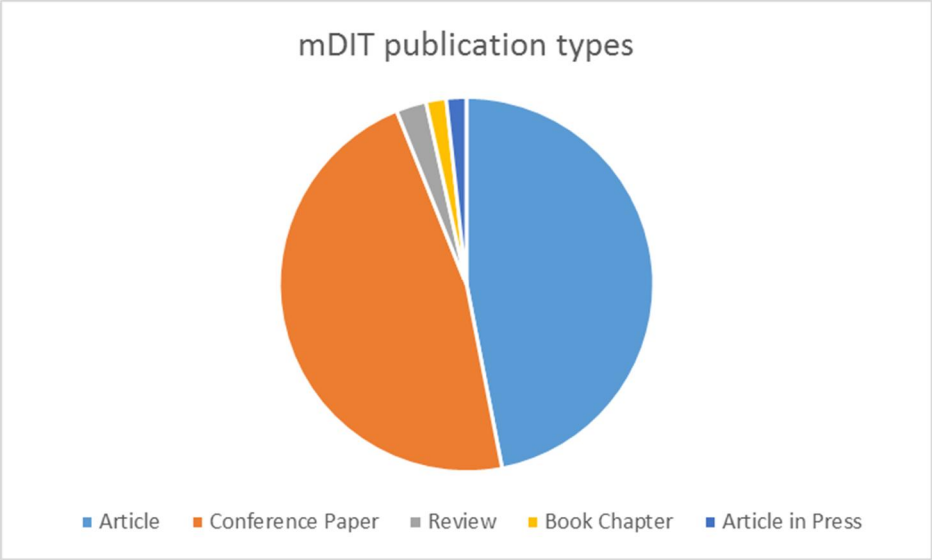


Figure 2. Publication types in Scopus dataset.

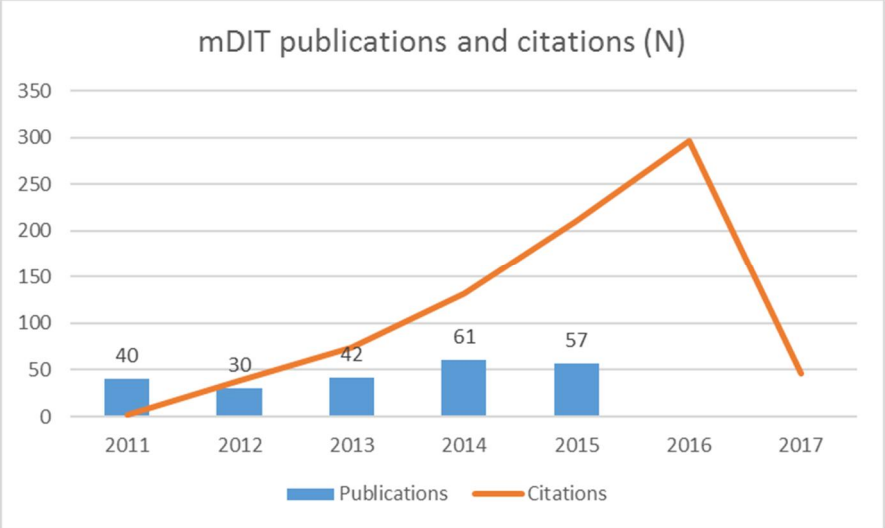


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

14. Prostate cancer research center (PCRC)

Head of Research Community: Olli Yli-Harja

Abstract

It would be critically important to be able to detect the lethal form of the malignancies at an early stage in order to be able to cure them and to avoid overtreatment. Prostate cancer (PC) is a typical example of a disease, which prognosis varies a great deal. It is the most common male malignancy in many Western industrialized countries. Although the vast majority of the diagnosed PCs are relatively indolent, PC is also the second most common cause of male cancer deaths. The key objective of the PCRC is to integrate multidisciplinary research on prostate cancer. Computational tools to integrate different levels of the analyses will be developed.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4 to 5

Prostate cancer is the second most common form of cancer in men world-wide. A feature of the disease is that the incidence among sufficiently old men is very high, but in most cases the disease is not diagnosed, not treated, and is not the cause of death. The lethal (aggressive) form of the disease is typically associated to metastasis. Good predictive markers that separate the lethal from the non-lethal form of the disease are presently lacking.

The RC is focused on the issue of understanding the lethal form of the disease, when it appears, how to detect it early enough that it can be treated, and the molecular mechanisms of disease progression.

The RC has impressive resources in the form of clinical samples of tumors and their microenvironment. The proposed research is at the international forefront, but not entirely revolutionary as to the proposed data analytics.

2. Societal relevance of research

Rating: 5

Prostate cancer is the most common cancer among men in Finland. The lack of good predictors of the lethal form of the disease lead to a risk of over-treatment while treatment may have serious side-effects on health and well-being. Improved treatment and improved diagnostics of the lethal form of the disease will both have very significant positive impact on society, both in Finland and world-wide.

3. Research environment

Rating: 5

The RC combines a very strong and large group from UTA in prostate cancer stretching from basic oncology to the clinic, one computational group from UTA and two computational groups from TUT.

The publication and citation profiles of the RC is outstanding, the list of achievement impressive and the presentation to the committee was very solid and convincing.

4. Potential of the Research Community

The essence of the RC's research plan is to combine very long and high-profile track record in prostate cancer (UTA) with part of the excellent computational resources in the Tampere area (TUT and UTA) to try to advance the understanding of the disease. This is an excellent initiative which has large potential benefits to both sides. It has particularly high potential for the computational biology groups which are already very prominent, but which would in this manner be able to leverage unique local resources and know-how to increase their international standing further and addressing a problem of very great societal relevance. It was not very clearly explained in the presentation exactly which new computational methods were going to be used, but methods used in preliminary (unsuccessful) work on public data were outlined to the Committee at the hearing.

The RC's research work definitely has the potential to make an impact on the scientific community and on society at large, and the RC is well aware of its standing in the scientific community.

The research conducted by the RC is highly innovative in its separate parts; the innovation of the integration has not been fully demonstrated yet.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 92%, which can be considered as excellent coverage. In the research community, there were 20 researchers whose publications were included in the analyses. There were 287 articles, 18 reviews and 20 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	310
TCS	8402.5
MCS	27.10

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	3.22
MNJS	2.19
PP(top10%)	26%
PP(uncited)	11%
Proportion of self-citations	16%
PP(collab)	94%
PP(int collab)	68%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	57.25	30.07	1721.5	2.17	2	16 %	5 %	18 %	95 %	63 %	95 %
2012	65.25	41.16	2686	3.21	2.4	30 %	11 %	14 %	94 %	66 %	93 %
2013	64.25	20.41	1311.5	2.08	1.49	19 %	2 %	21 %	97 %	75 %	90 %
2014	48	32.83	1575.75	3.82	2.7	32 %	16 %	15 %	93 %	74 %	91 %
2015	75.25	14.72	1107.75	4.64	2.42	31 %	21 %	11 %	91 %	64 %	92 %

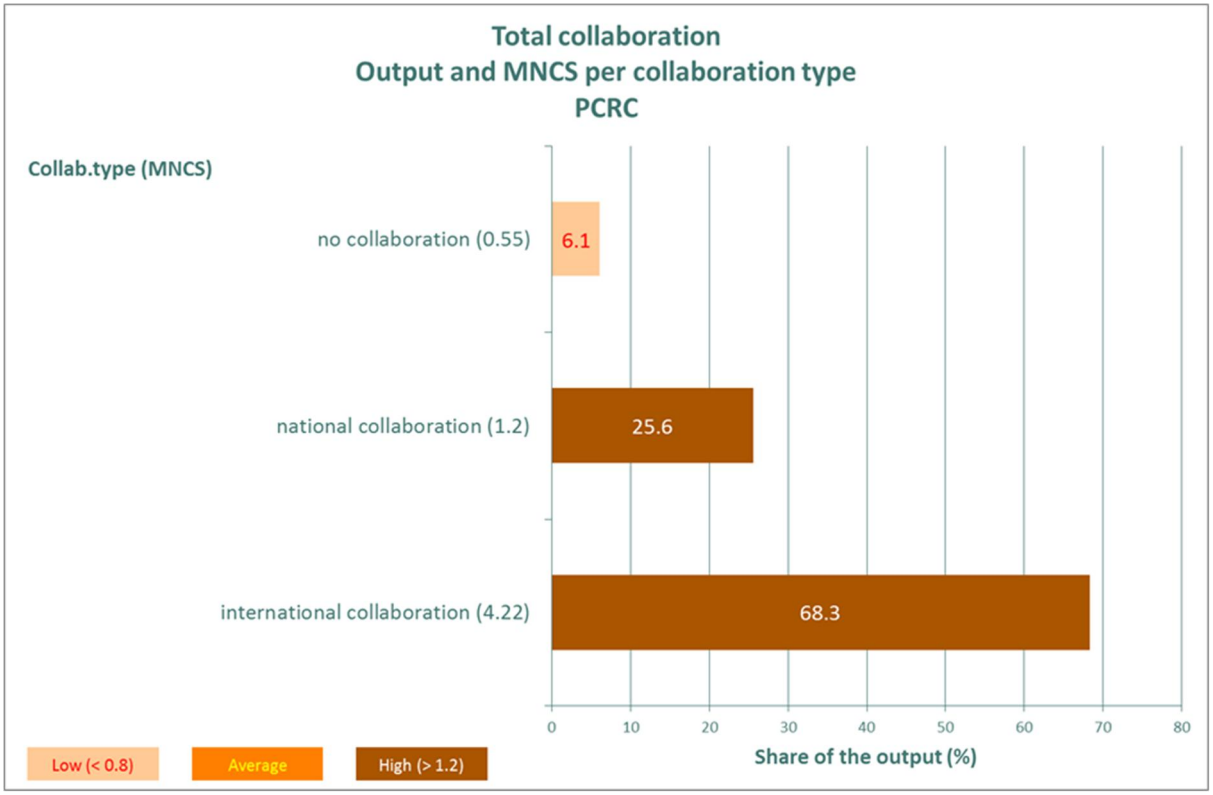


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 91%, which is considered as excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	338
H-index	39
TCS	9033
MCS	26.7
N-uncited	49
PP(uncited)	15%
Proportion of self-citations	16%

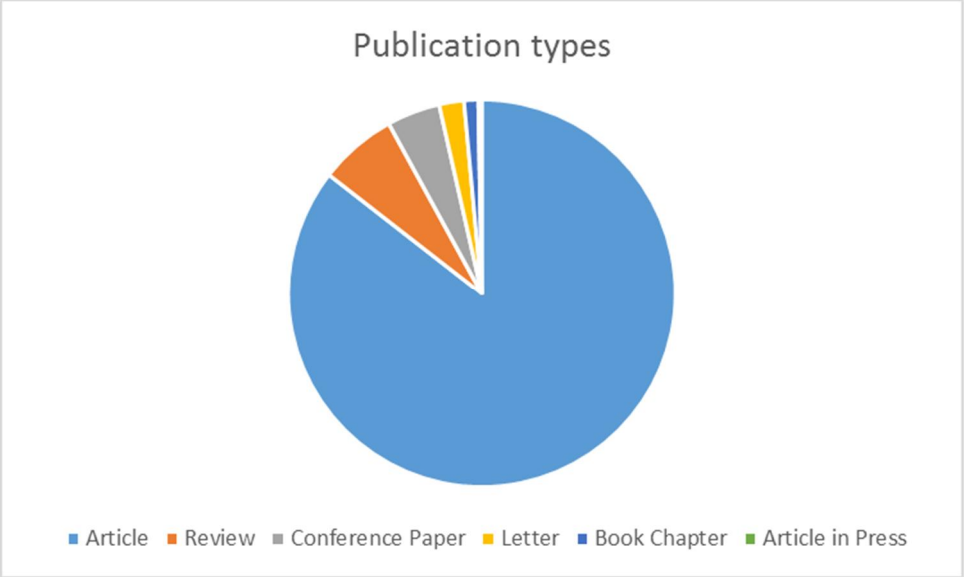


Figure 2. Publication types in Scopus dataset.

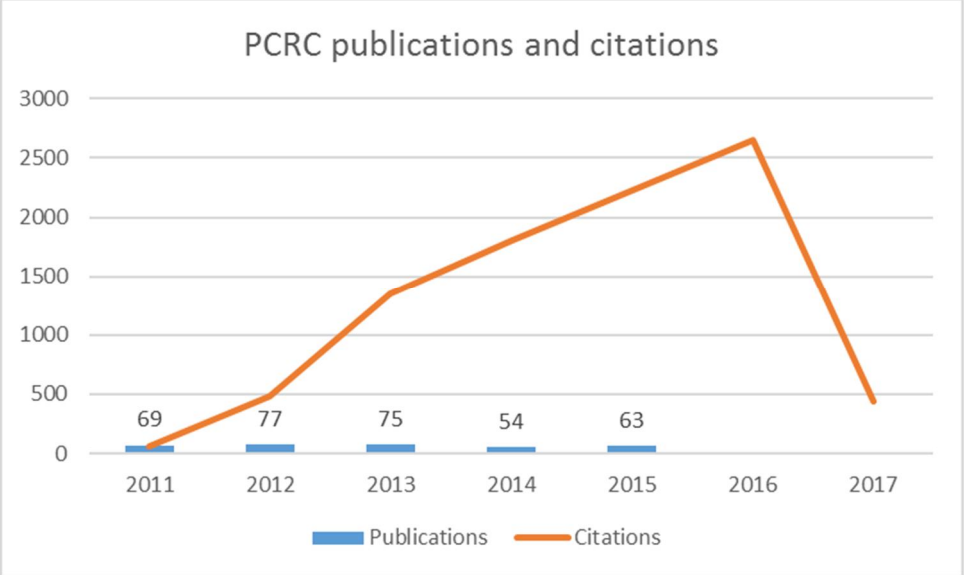


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

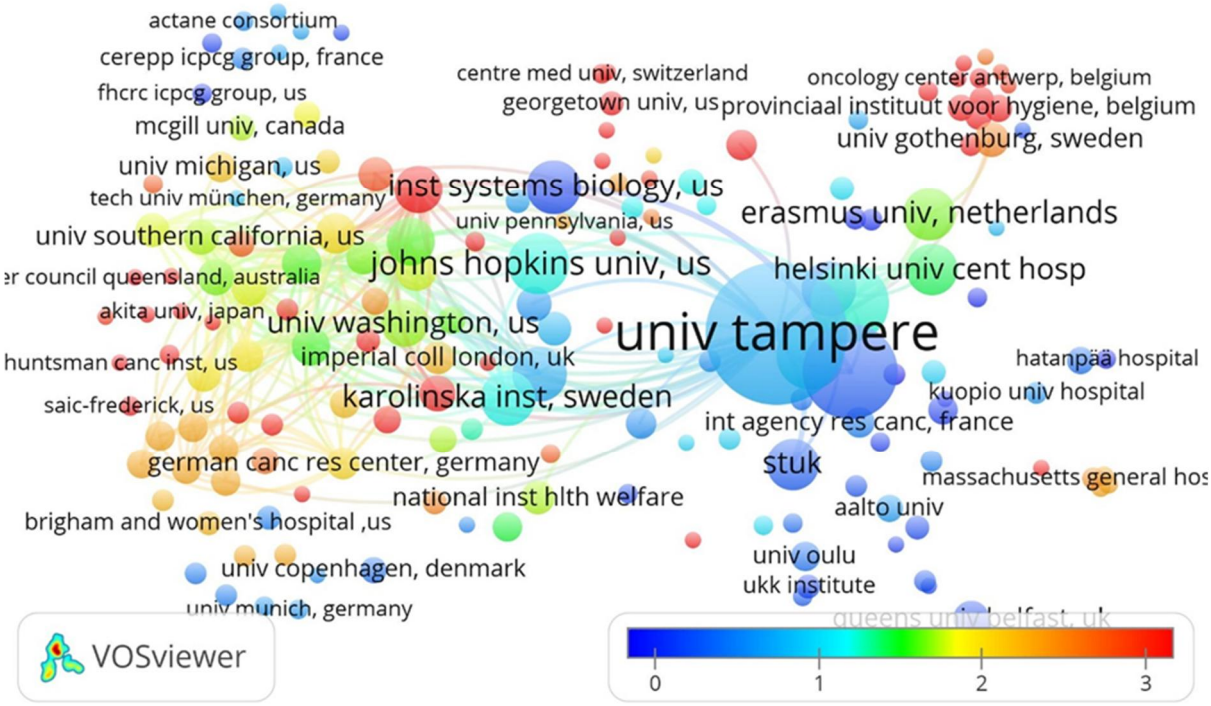


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

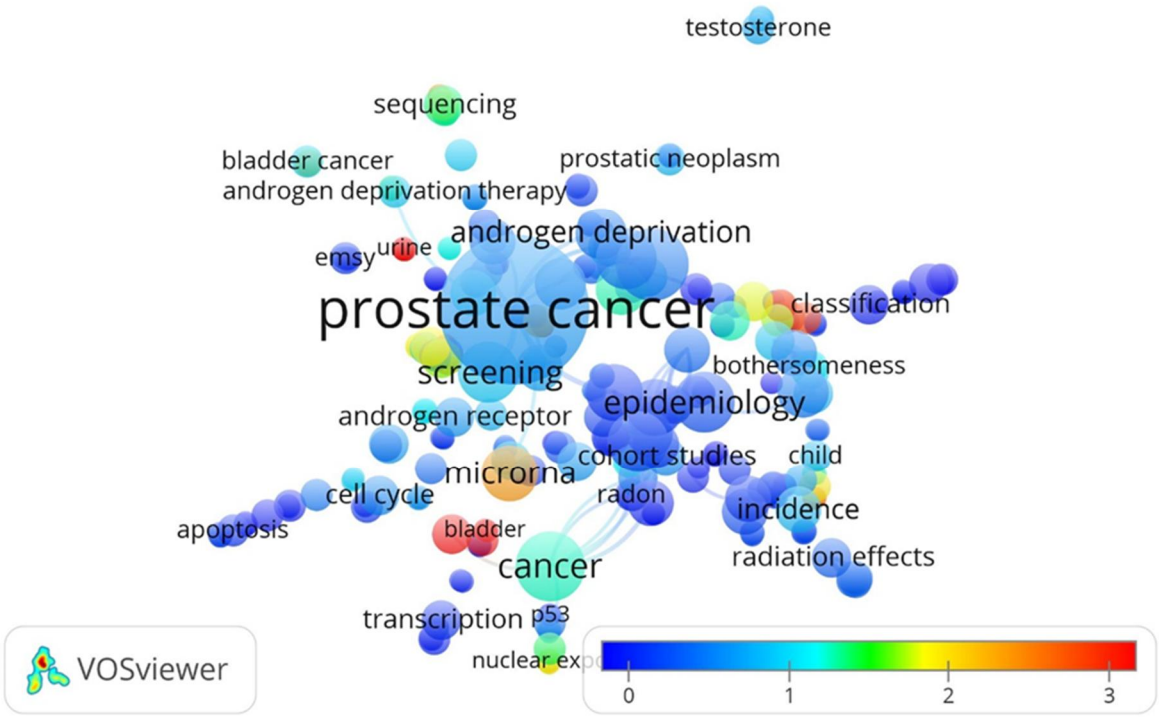


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

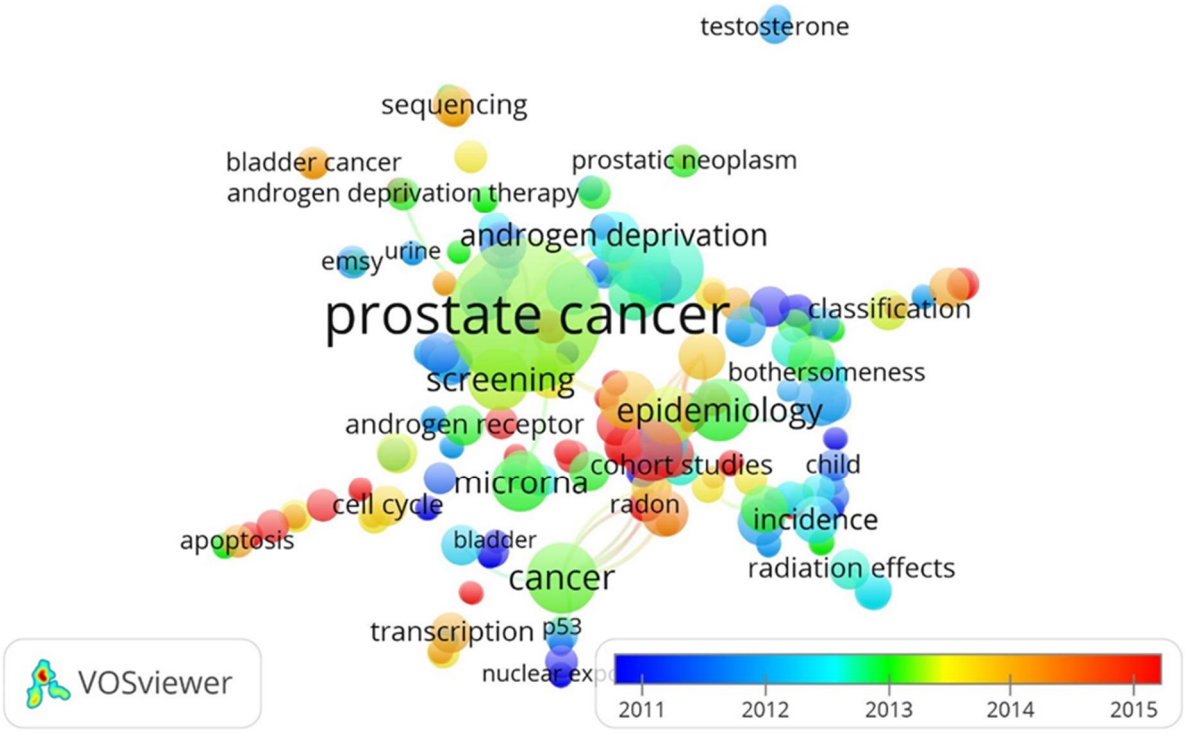


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

15. Research Community on Data-to-Decision (D2D)

Head of Research Community: Moncef Gabbouj

Abstract

Data-to-Decision (D2D) is a newly created multi-disciplinary research community (RC) whose objectives are to (a) develop original data-driven theories, methods, algorithms, and systems for massive data based on principles from the fields of signal processing, pattern recognition, data mining and machine learning, (b) solve real-world problems with high societal impact, and (c) train talented researchers in these fields. D2D's first two objectives will help us fundamentally innovate the way large-scale data is analyzed, interpreted, and leveraged towards new application with high societal impact and relevance.

D2D has the potential to spur new scientific methodologies, products, services, and practices. As pointed out in [1], this *"global trend [brought by massive data] holds enormous potential in various fields"* and "data-driven innovation brings vast new job opportunities." D2D holds great promise for discovering subtle patterns and hidden characteristics that are not possible with small-scale data; on the other hand, the massive size of the data and the high dimensionality introduce unique theoretical and computational challenges, which require *new disruptive paradigms*. Specifically, we aim at developing new theories, methods and algorithms for data representation, data analysis and machine learning by fundamentally up-scaling existing theories and models and proposing new ones for massive data. Through extensive national and international collaboration, we seek to develop solutions to pertinent problems and applications with high societal impact, such as biomedical and health; public transportation and traffic; finance; safety and security; as well as audio-visual media.

We see great opportunities for breakthroughs in this research area. D2D facilitates open exchange of ideas and explores High Risk/High Gain research. With the RC status, we position ourselves among the leading research units in the world in our area. D2D provides significant synergy benefits because of our complementary theoretical backgrounds and the planned co-operation among the teams. Societal impact arises form original contributions to the scientific community, including defining new research tracks; breeding top talent; and improving the quality of life with disruptive applications in collaboration with research units and industry.

Reference:
[1] Towards a thriving data-driven economy. Communication to the European Parliament, European Economic and Social Committee, and the Committee of the Regions, COM (2014) 442 Brussels.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

The topics to be studied by this RC fall within the data science discipline, which is one of the driving forces in today's technology. The proposed research is at the cutting edge and, it is of very high quality and the members of the RC have extensively published in the top journals in the related areas. Thus, the impact of their research stands out with respect to publications. The RC has the expertise and experience that could generate ground-breaking and disruptive research, and it should be more ambitious in pushing the research boundaries and taking the

lead role in driving the field forward. It would need more tangible application oriented output, such as patents or adoption in products. This is something that the members of the RC should give an emphasis to and pursue further in the future. In particular, the interface to decision-making is not clear, as its focus is more in the data-science.

2. Societal relevance of research

Rating: 3

The proposal embraces a large number of diverse application areas, ranging from audio and video to healthcare. From this point of view, the research touches upon a number of application areas of strong current interest. However, the proposal lacks in focus that can lead to a more tangible output, which is related to the exploitation of the results, e.g., via start-ups or open source software to be used by the scientific community.

3. Research environment

Rating: 4

The members of this RC have a strong publication record in top journals and some of the members are international highly recognised, e.g., ERC starting grant, IEEE Fellowship, Finnish Academy Award. They have also attracted good amount of funding via Finnish as well as EU projects, including one in which one of the members is the consortium coordinator. Moreover, members of the RC have established international cooperation with other institutions in different areas. The bibliometric indices stand at a respectable level in the specific field. The RC has a large network in different areas, in particular in the medical area.

4. Potential of the Research Community

The RC undoubtedly has a lot of potential. The formation of the RC will help to boost cooperation among its members and it will bring closer a critical mass of good people. Taking into account that one of the goals and envisaged impacts of the proposal is to systematically integrate and examine various input modalities, while treating heterogeneous data, the complementarity of the expertise of its members can be catalytic towards this direction. Selecting and focussing on a few specific application areas will give the RC more chances to achieve a more lasting impact of their research.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 59%, which can be considered as good. However, a great share of references are outside the coverage. Therefore, the bibliometric analyses should be considered carefully. In the research community, there were 32 researchers whose publications were included in the analyses. There were 183 articles, 2 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	185
TCS	1019
MCS	5.51

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.3
MNJS	1.09
PP(top10%)	12%
PP(uncited)	26%
Proportion of self-citations	21%
PP(collab)	78%
PP(int collab)	58%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	29	8.55	248	1.22	1.14	10 %	10 %	31 %	86 %	69 %	55 %
2012	33	12.64	417	2.09	0.87	9 %	21 %	9 %	67 %	48 %	63 %
2013	37	4.03	149	1.05	1.18	14 %	24 %	27 %	78 %	51 %	55 %
2014	45	3.11	140	1.06	1.09	15 %	24 %	23 %	78 %	53 %	60 %
2015	41	1.59	65	1.22	1.14	13 %	44 %	16 %	83 %	68 %	61 %

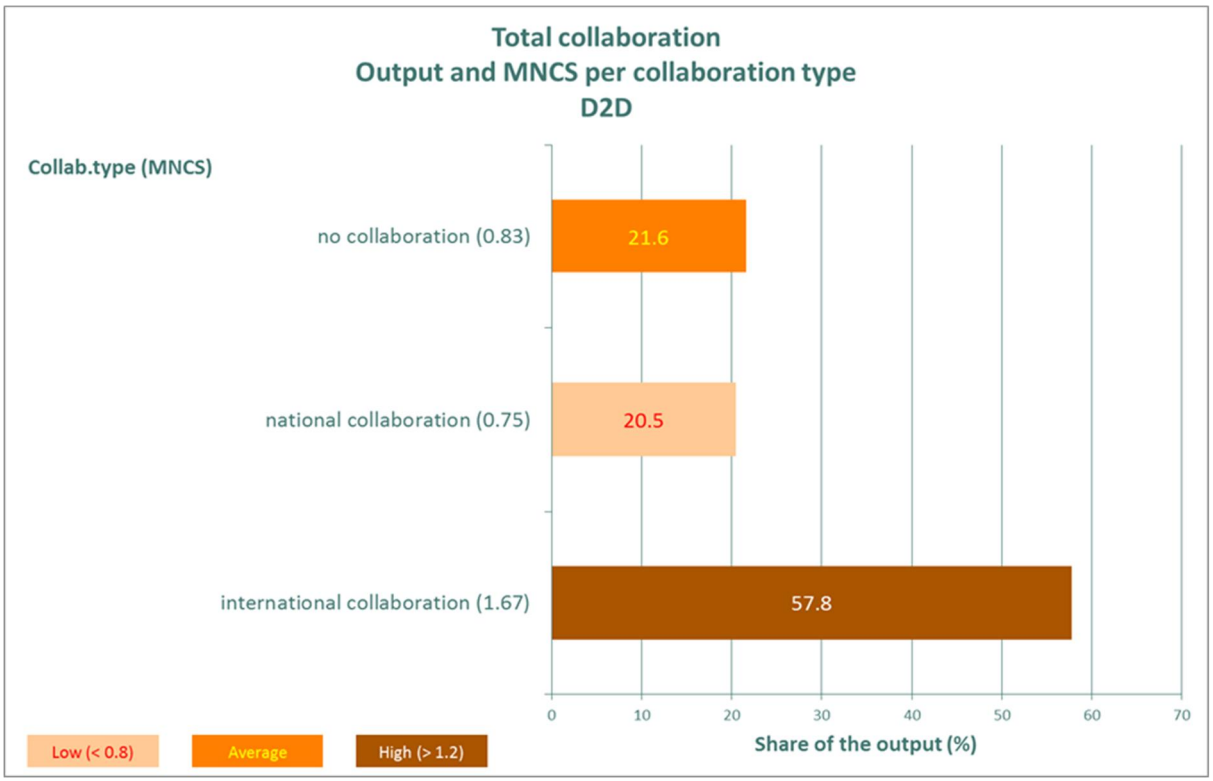


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 57%, which is considered as good. However, a great share of references appear outside the coverage. Therefore, the bibliometric analyses should be considered very carefully.

Table 4. Scopus indicators

Indicator	Performance
P	550
H-index	24
TCS	3538
MCS	6.4
N-uncited	230
PP(uncited)	41%
Proportion of self-citations	21%

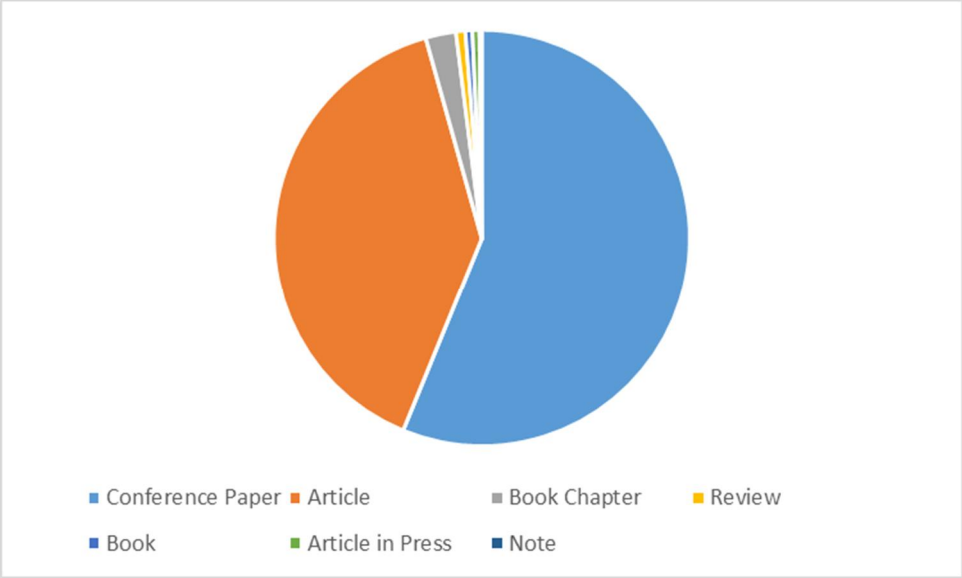


Figure 2. Publication types in Scopus dataset.

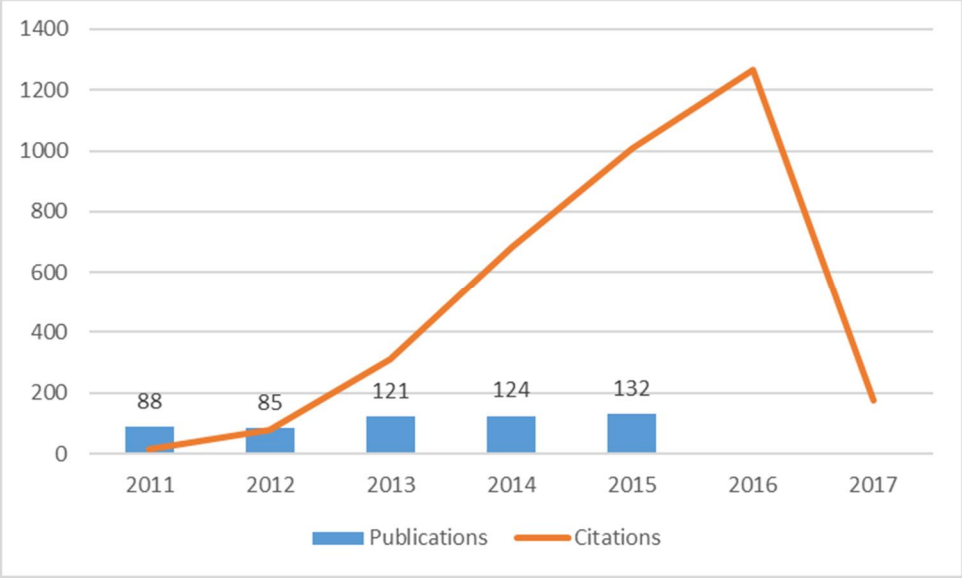
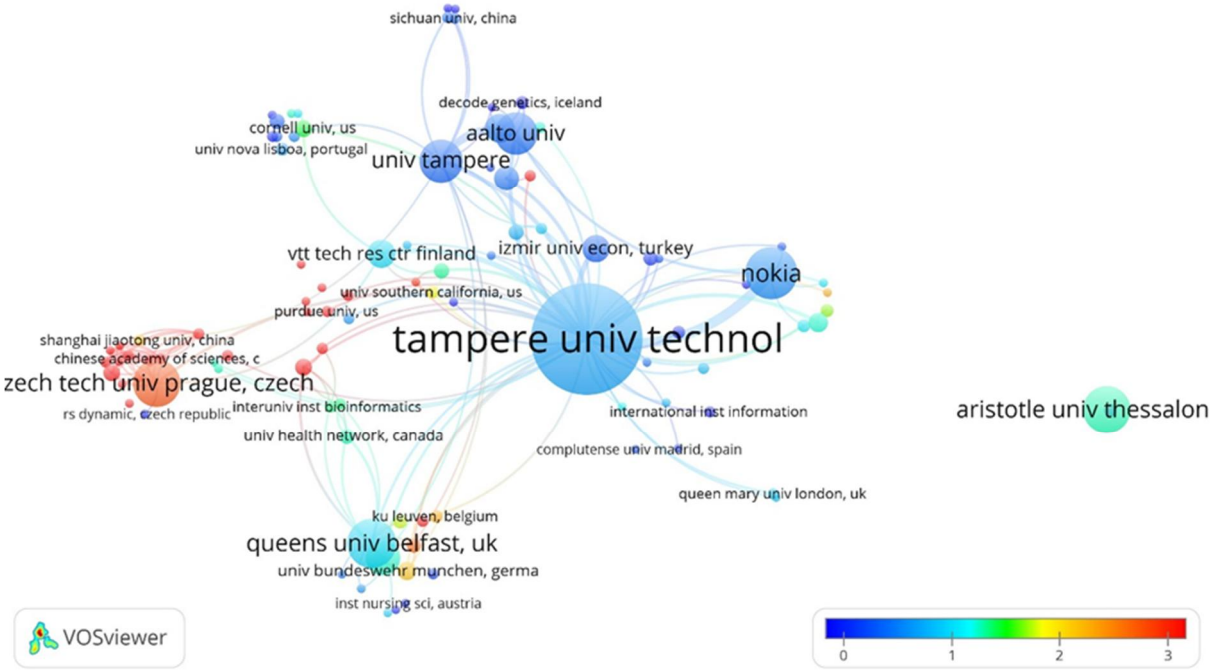


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.



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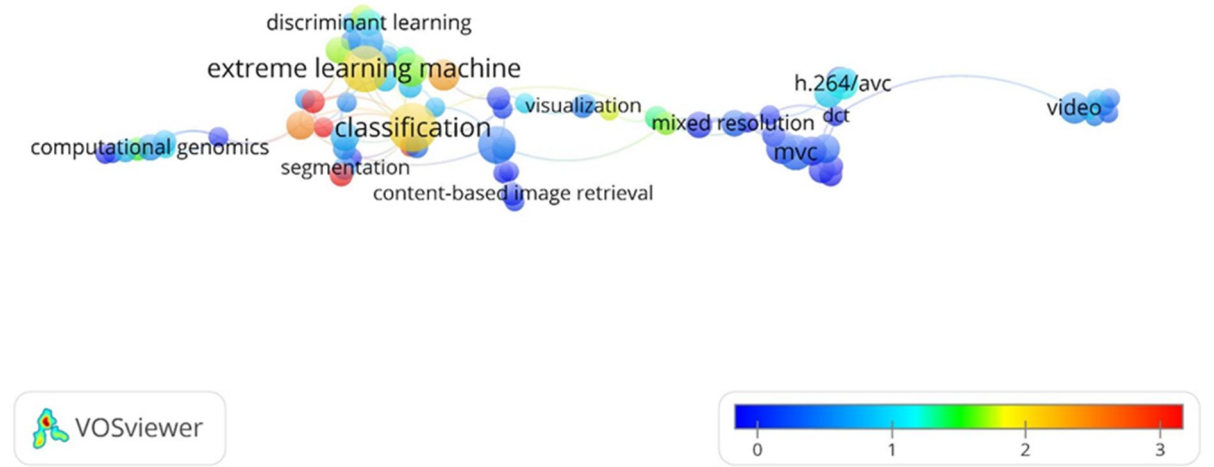

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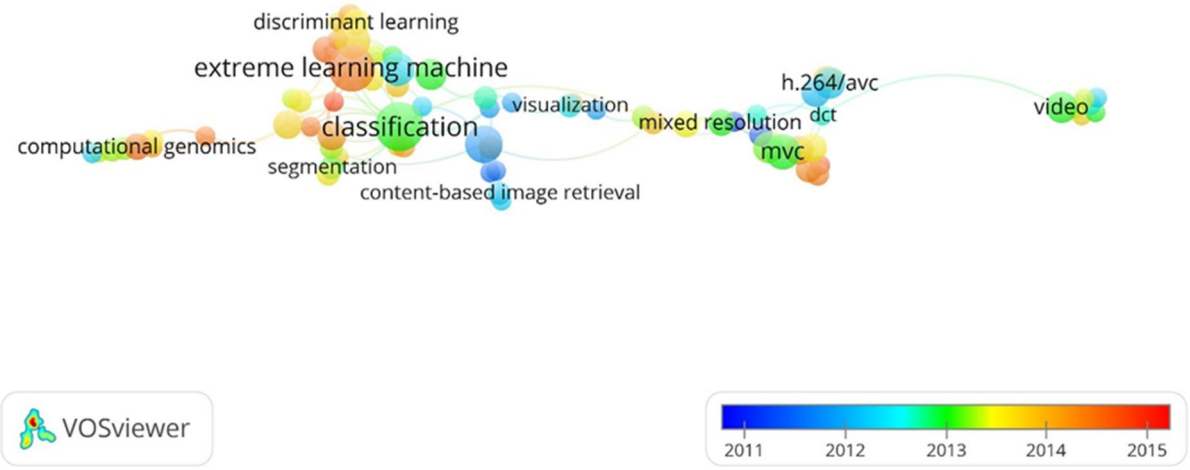

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16. Sensing Systems for Wireless Medicine (MediSense)

Head of Research Community: Leena Ukkonen

Abstract

In this research community, a novel wireless multi-implant intra-body sensing network will be created. This research work will solve the fundamental challenges on implant-to-implant coupling, communication and power transfer to form a wireless intra-body sensing system. Biggest challenge is measuring the human body with the created novel sensors and integrating the components into a functional intra-body sensing system, which communicates to on-body devices. This approach exceeds the state-of-the-art implantable systems by studying the interactions between electromagnetically coupled, very small implants to form a sensing network inside the body and by providing a new system level concept, which is feasible in longterm treatment and monitoring. If successful, the research work will revolutionize the treatment of many severe diseases and provide comfort and safety for patients. Impact of the results will be widespread in biomedical technology in curing and monitoring of intra-body diseases, monitoring of body functions and creating information for proactive healthcare. The results of this project have the potential to improve the quality of life globally.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 3 to 4

This relatively small research community has generated many highly cited articles, which have shown the quality of its research. In addition, the community has established itself to be at the forefront of implantable antenna for intracranial pressure sensor, and pushed the development from simulation to animal study. It is very challenging for an electrical engineering group to translate its technology to animal study. However, apart from the implantable antenna, their other new areas, such as textile antenna and multiple implant sensor network, are still in their infancy, and their potential impacts are not apparent. In addition, majority of its publications are joint publications with its international collaborators, but it is not clear how many of its highly cited papers are led by the external groups instead of this RC. Its research could be strengthened by establishing/expanding its collaborations with other complementary RCs, and taking the lead role in its publications.

2. Societal relevance of research

Rating: 3

This research community is tackling a major technical challenge in developing a robust implantable antenna for intracranial pressure measurement and which could facilitate the development of robotic prosthetics. It could lead to significant benefit to hydrocephalus patients, and also become an important component of robotic prosthetics and benefit amputees and paralytics. However, having just completed the first animal trial, it is still a long way before it can be applied clinically. It will require significant investment, strong clinical collaborations and industrial partnerships to realise the concept and generate the expected impacts. In addition, it has not generated any patents or initiated any start-up companies yet, and which could jeopardise its chances to attract investments.

3. Research environment

Rating: 3

It has established strong links with many international groups through joint publications and students/researchers exchange. However, it has very limited international funding. For this relatively small community, the amount of funding and support is reasonable, but it will need significant investment to build up its facility and expand its team to boost its research, especially if it plans to push its work to clinical validation. It should work with other RC's and its international collaborators to seek Finnish, EU and other international funding to support its growth.

4. Potential of the Research Community

This research community has a clear focus on wireless multi-implant intra-body sensing network and has developed an implantable antenna for intracranial pressure measurement. Its work could lead to significant benefit to patients with hydrocephalus and facilitate the development of robotic prosthetics. Its research has generated much interest in the research community with many highly-cited publications. However, its research has been strongly dependent on its collaborations with other international partners, although such arrangement has helped its growth, it needs to start reduce such dependence and establish itself. It needs to seek further funding and support, expand its team and facilities, generate patents and IPRs, and build up its industrial and clinical collaborations. In addition, it could benefit from building stronger links with other RCs.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 54%, which can be considered as good coverage. However, almost half of the research on their field exists outside the coverage. Therefore, the bibliometric analysis should be considered very carefully. In the research community, there were 10 researchers whose publications were included in the analyses. There were 114 articles, 0 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	114
TCS	699
MCS	6.13

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.86
MNJS	1.28
PP(top10%)	22%
PP(uncited)	15%
Proportion of self-citations	24%
PP(collab)	85%
PP(int collab)	75%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	20	11.5	230	1.79	1.31	16 %	15 %	22 %	85 %	75 %	49 %
2012	21	6.62	139	1.34	1.01	11 %	5 %	24 %	86 %	76 %	51 %
2013	27	7.3	197	2.17	1.53	29 %	4 %	25 %	78 %	74 %	55 %
2014	15	5.07	76	2.77	1.47	37 %	7 %	18 %	93 %	80 %	52 %
2015	31	1.84	57	1.56	1.15	19 %	35 %	30 %	87 %	74 %	60 %

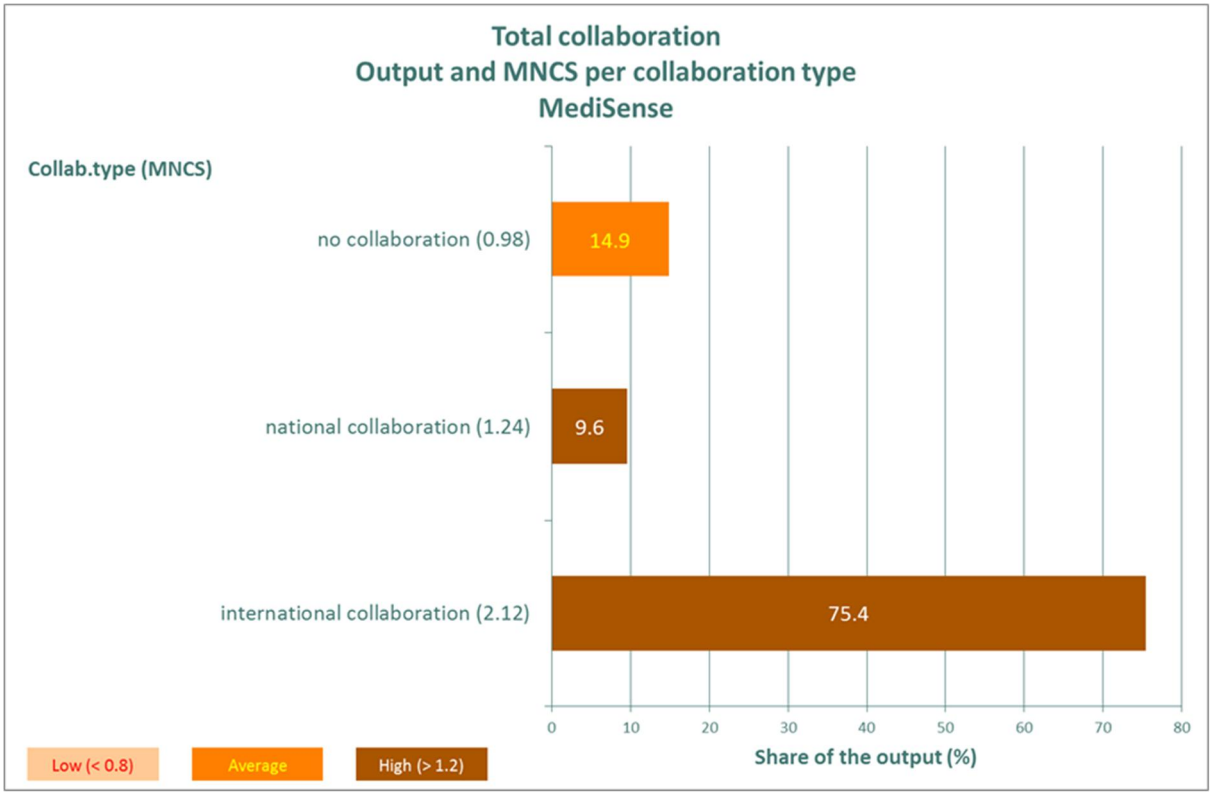


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 52%, which is considered as good coverage. However, almost half of the research on their field exists outside the coverage. Therefore, the bibliometric analysis should be considered very carefully.

Table 4. Scopus indicators

Indicator	Performance
P	388
H-index	22
TCS	1794
MCS	4.6
N-uncited	170
PP(uncited)	44%
Proportion of self-citations	33%

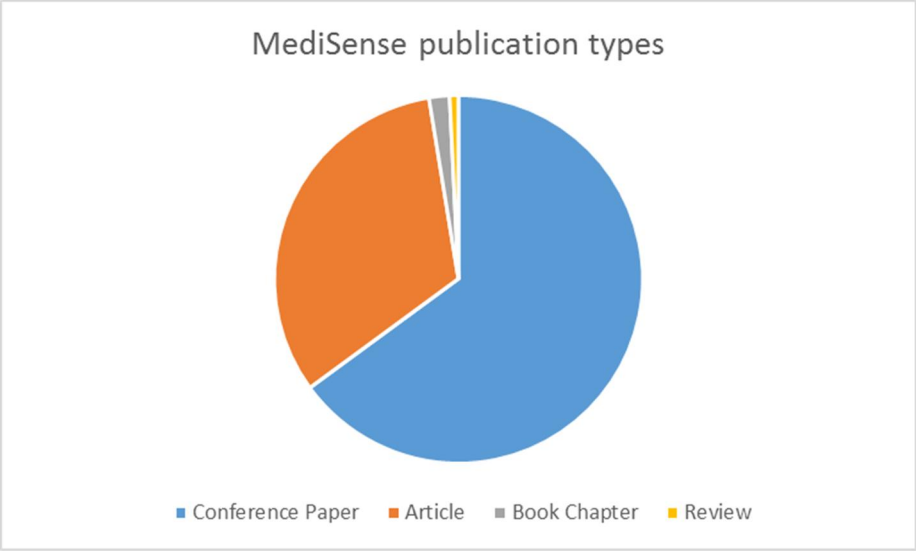


Figure 2. Publication types in Scopus dataset.

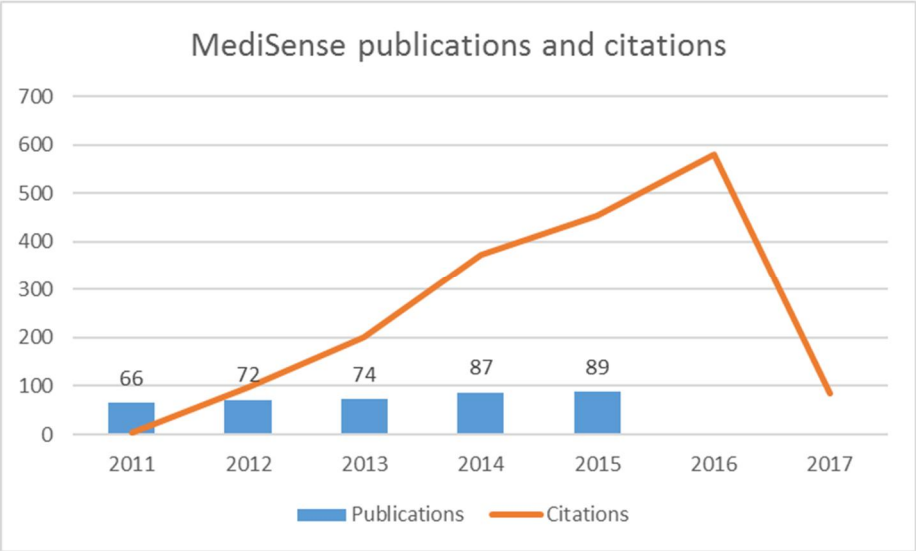


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

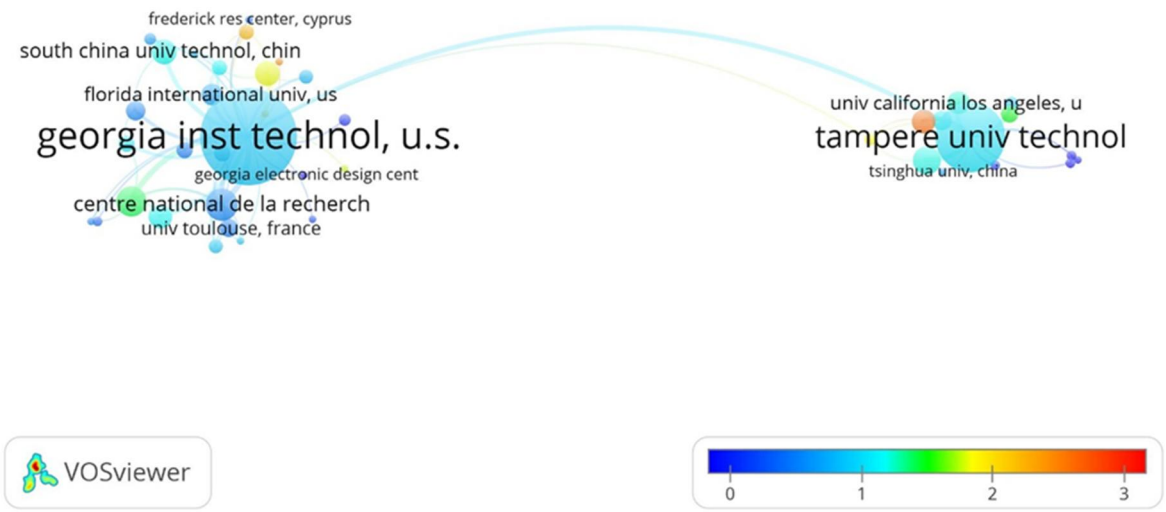


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

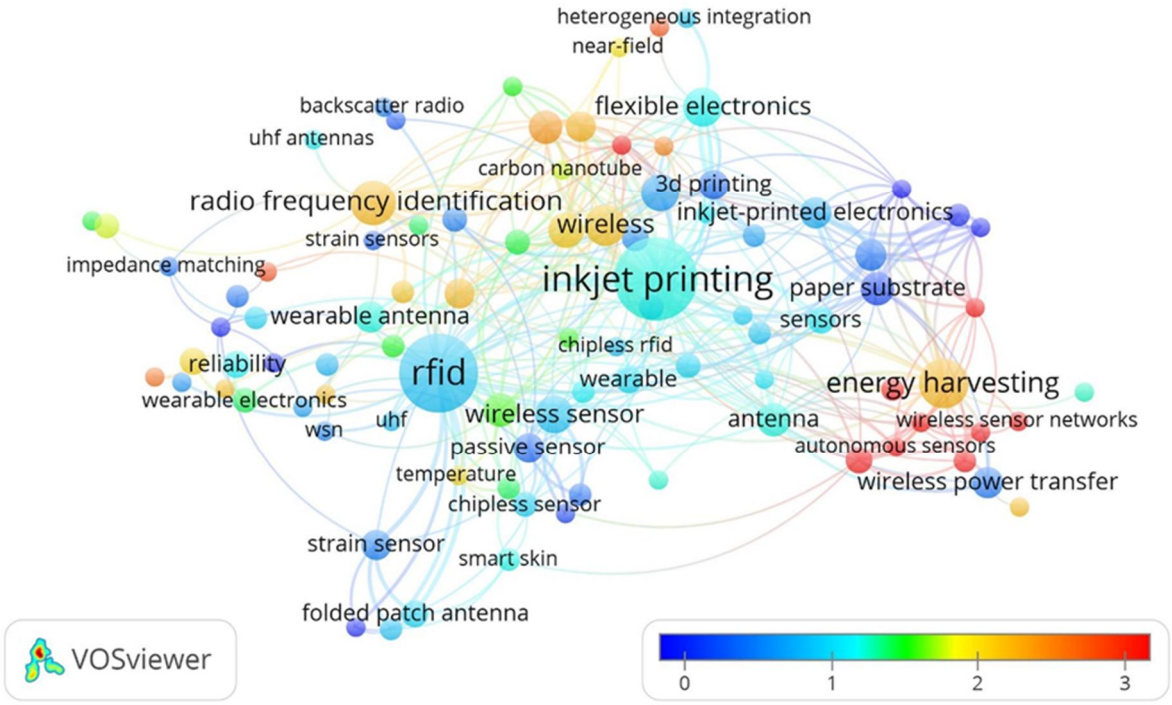


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

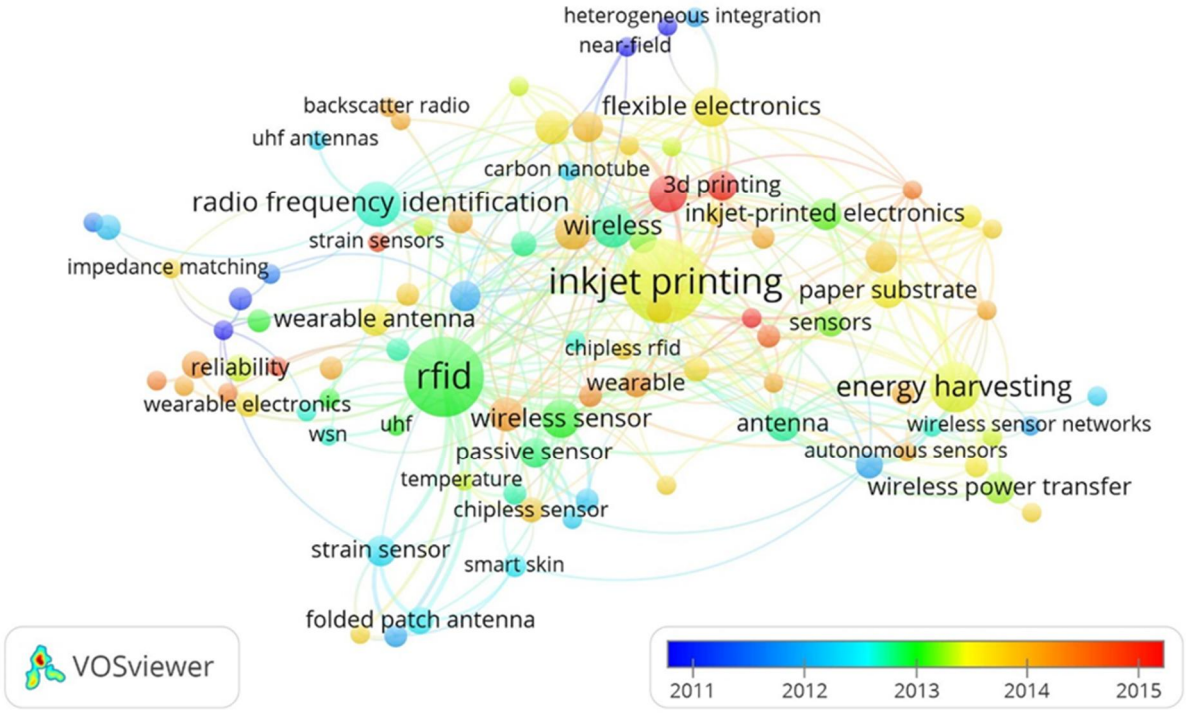


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

17. Signal Processing Research Community (SPRC)

Head of Research Community: Karen Egiazarian

Abstract

Signal Processing (SP) is behind our digital life and some kind of SP can be found in every modern device. Smartphones allow users to input text with voice, take high-quality photos, and authenticate with fingerprint analysis. Wearable devices measure heart rate and calories burned during a run. In TV, content can be accessed in 3D and with higher resolutions. Game consoles let users interact with the game by tracking their arm and body motions. Hearing aids improve millions of lives. Ultrasound machines and medical scans are life-saving advances in health care. The advances in SP will change our lives even further. There will be new interactions between humans, between humans and machines, and between machines. SPRC addresses the economical and societal challenges by formulating pivotal scientific research questions. Their solutions will be the next breakthroughs in signal processing and they can be achieved only by synergistic collaboration on a broad range of research topics.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

The research to be conducted is of very high quality and very ambitious. The proposed research and techniques are at the forefront of today's technology in the areas of signal and image processing. The tasks, to be undertaken, address important problems, such as video and audio coding as well as modern tasks related to the emerging 3D immersive visual technologies. These areas comprise indispensable tools at the heart of what we call information and knowledge societies. They make possible the storage and distribution in communication networks and social media of important modalities, such as images, video, music. 3D immersive technologies play a key role in the gaming industry, which is a multibillion one, with worldwide applications.

2. Societal relevance of research

Rating: 4

Signal and image processing are among the key areas in today's technology. They are the technologies that interface the real world with the computer and communication networks. Without them, mobile phones, digital television, communication networks and social media would not be possible; the distribution and storage of information is heavily based on related techniques. Furthermore, image and video processing techniques are at the heart of many medical applications such as MRI scanners and mammography. Thus, their societal relevance is of the highest value. Moreover, this community, via an existing spinoff, has made its societal value tangible, since results that have been produced in an academic environment are provided directly as service to the wider society.

3. Research environment

Rating: 4 to 5

The research environment is outstanding. The members of the group publish in the top journals in the field, of the highest impact factor, they have received a number of prestigious awards and they are highly cited. Moreover, the members of the community comprise a very good balance between theory and application oriented work.

4. Potential of the Research Community

The potential of the community is very high. The research group is of the highest quality and the proposed research focusses on very timely topics of high interest not only to the research community but also has high potential in the applications front.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 44%, which can be considered as good. However, over half of the references appear outside the coverage. Therefore, the bibliometric analyses should be considered very carefully. In the research community, there were 32 researchers whose publications were included in the analyses. There were 130 articles, 0 reviews and 1 letter in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	130.25
TCS	638.75
MCS	4.9

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.43
MNJS	0.98
PP(top10%)	14%
PP(uncited)	36%
Proportion of self-citations	16%
PP(collab)	58%
PP(int collab)	49%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	22.25	7.04	156.75	1.3	0.97	9 %	36 %	20 %	63 %	54 %	35 %
2012	31	7.48	232	1.5	1.09	16 %	26 %	13 %	65 %	48 %	46 %
2013	28	4.68	131	1.29	0.87	10 %	29 %	15 %	46 %	39 %	46 %
2014	25	3.52	88	1.59	1.15	18 %	28 %	15 %	52 %	44 %	45 %
2015	24	1.29	31	1.48	0.8	14 %	67 %	18 %	67 %	63 %	48 %

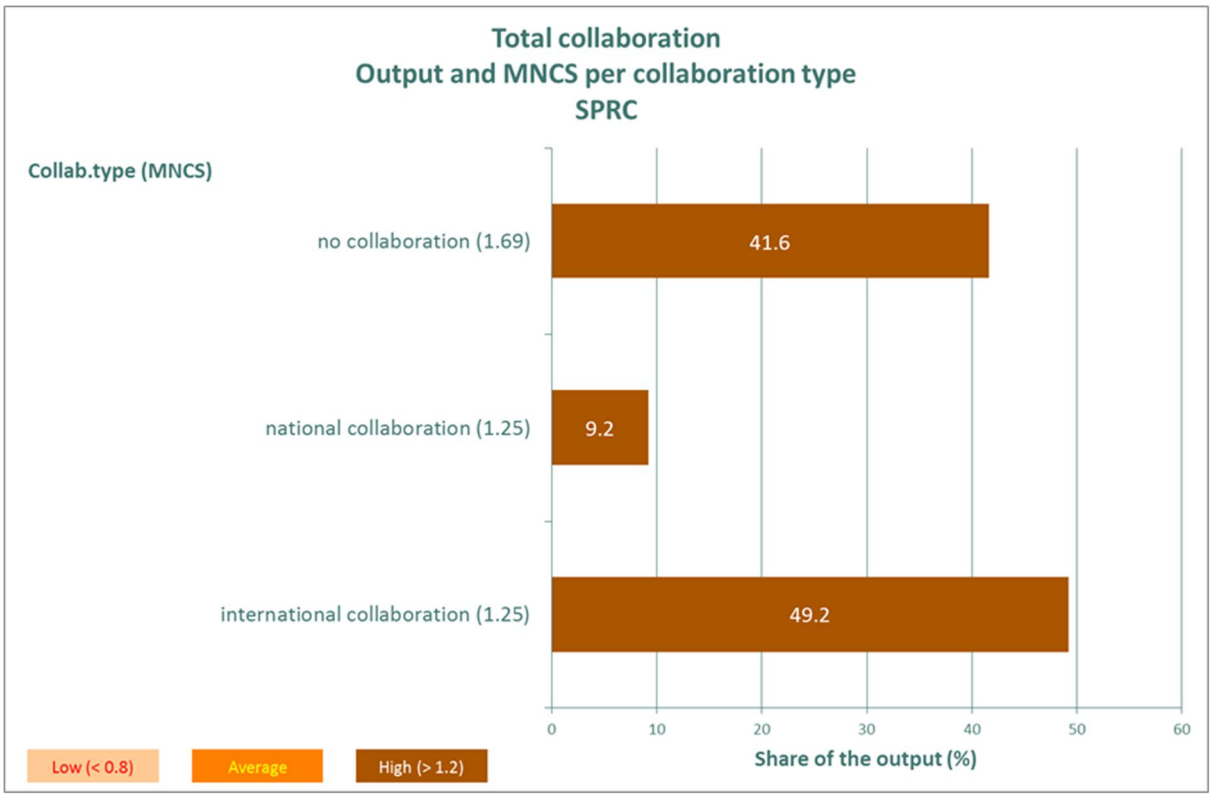


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 53%, which is considered as good coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	520
H-index	20
TCS	1969
MCS	3.8
N-uncited	271
PP(uncited)	52%
Proportion of self-citations	26%

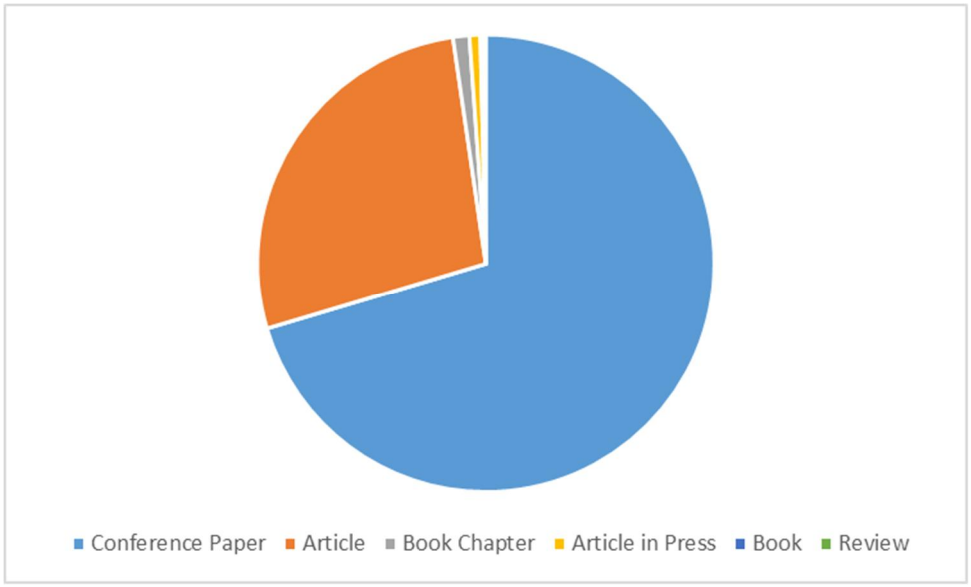


Figure 2. Publication types in Scopus dataset.

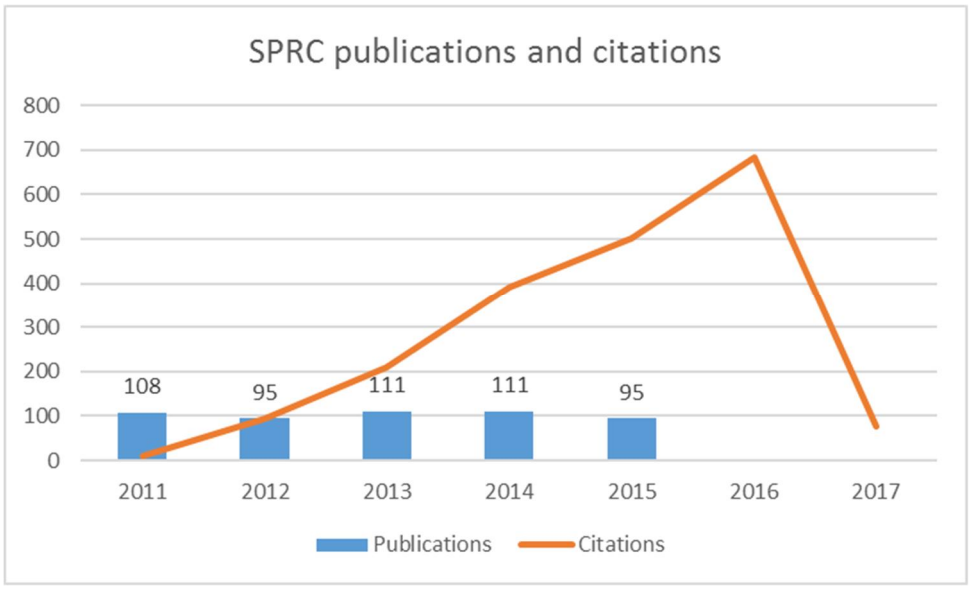


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

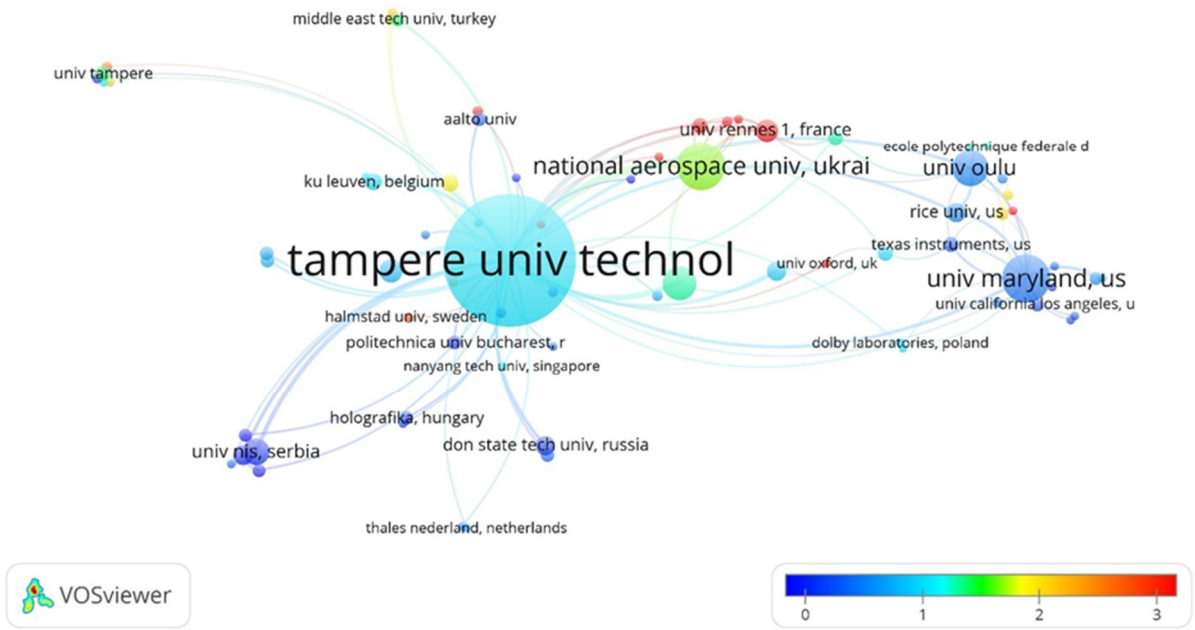


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

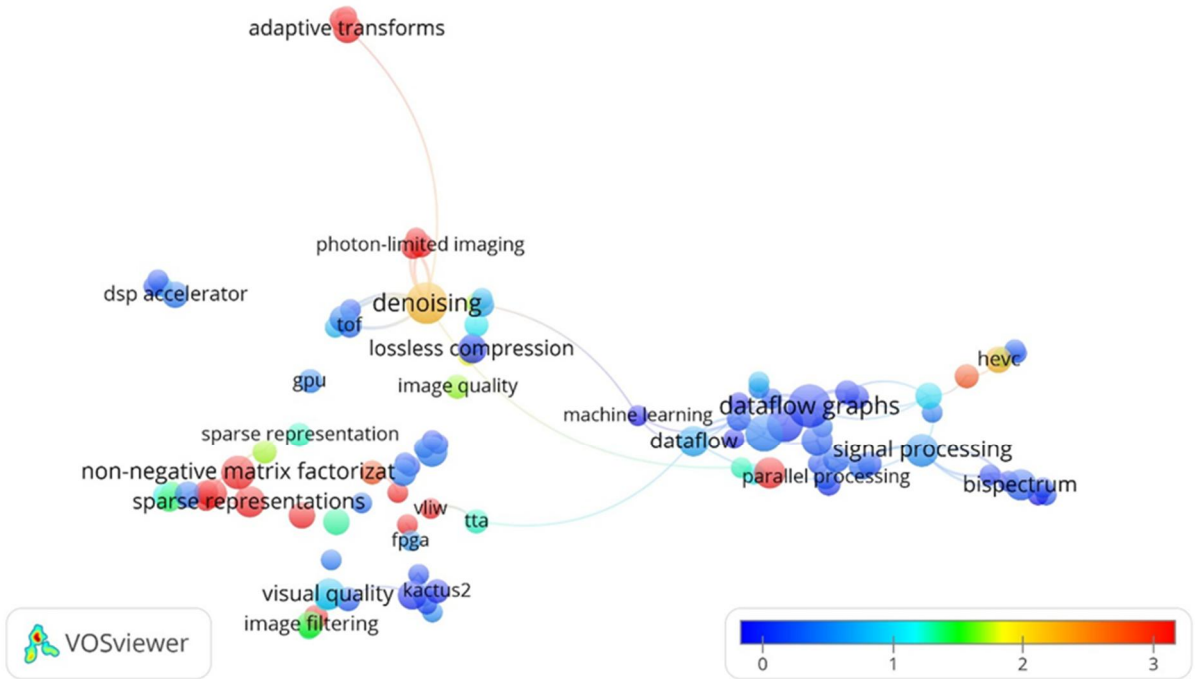


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

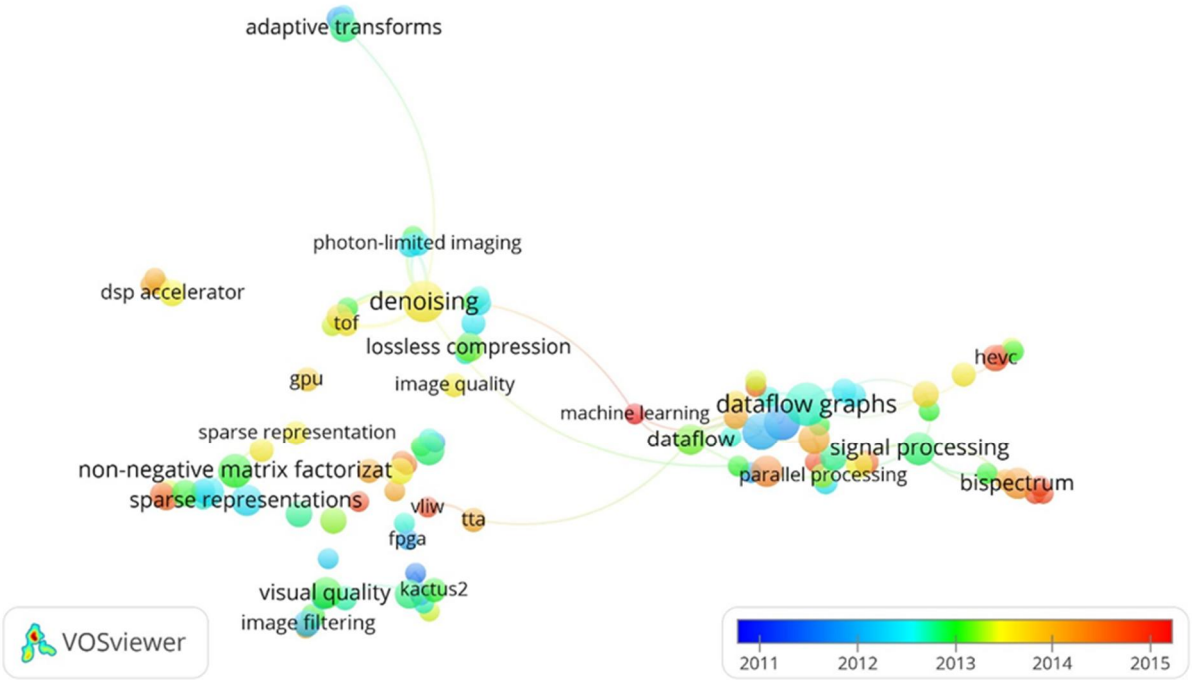


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

18. Smart Energy Systems (SES)

Head of Research Community

Abstract

The global challenge dealing with climate change and resource scarcity requires big changes in energy system. In energy production, there is need to shift from fossils to renewables – especially to solar and wind energy, which will also be the most economical ways to produce electrical energy in the future and will dominate the production. The decentralized and weather dependent production requires smart electricity network, energy storages and demand response and in the energy utilization there is need for more energy efficiency and smartness. The research community (RC) Smart Energy Systems (SES) focuses on research and development of new solutions for this energy system challenge. The research scope includes flexible and renewable (i.e. solar and wind) power generation, energy storages, their network connection and system impacts, smart grids, demand response, system security, energy efficiency and advanced materials. In addition to new technical solutions business models as well as associated regulatory framework is in the research scope. The five-year plan of the research community is to yield remarkable scientific and societal impact.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 2

The RC consists of experienced researchers who have specialized particularly in the areas of power electronics, power engineering and control engineering and has strong facilities to carry out further successfully in their defined areas. However, they ambitiously declared their RC on ‘smart energy systems’ which requires much more expertise than they currently have to be able to cover the entire spectrum of energy, ranging from energy production to energy management (including patterns recognition and smart metering). It could have been much better if they had enhanced their current areas of expertise in the direction of smart energy applications. The RC has carried out some successful studies and projects on: low voltage network, power electronics, optimal control, distribution network operation and planning, simulation tools, electrical insulation systems, PV generators, VSC-HVDC, solar power grid orientation and magnetic materials modeling. Moreover they provided services to several power plants and companies locally. However, they lack ground breaking research and innovation, leading to little impact due to low number of scholarly publications (95 papers during the past 5 years). They do also have low numbers of citations (433 the past 5 years), few true international collaboration, little innovative research and relatively small (limited) funding for about 70 people. The RC did not provide a clear vision and mission. The definition of SES is loose and they lack partnerships with leading groups on national or international level.

2. Societal relevance of research

Rating: 2

Although the potential relevance of this research is quite high, the RC has been unable to convince the panel that they can make a great impact on the society and economy. The experienced members of the RC are able to provide services to local companies and utility power plants. Such services are definitely beneficial. Since this is about research, they have to make difference by research, innovation and commercialization. The RC researchers have

to define their mission and vision, and set the goals with a clear focus. They have to recruit key people in the strategic areas and create a kind of center of excellence and establish themselves accordingly.

3. Research environment

Rating: 2

As mentioned above, the RC has got experienced researchers in the specific areas of power electronics, power engineering and control engineering (with a young member on magnetic materials modeling). However, the RC members have not yet established themselves internationally to create a unique center of excellence for a productive research environment. They need prolific researchers to do this. It is also important to note that they have good facilities on the specific areas of power electronics, power engineering and control engineering. The panel strongly recommends to actively recruit female faculty members.

4. Potential of the Research Community

The potential of this RC is limited with the current expertise. As mentioned above, they have to define their mission and vision and set the goals with a clear focus. They also have to recruit prolific researchers in the strategic areas and create a kind of center of excellence and establish themselves accordingly. Furthermore, they have to aim to make difference by research, innovation and commercialization.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 66%, which can be considered as very good coverage. In the research community, there were 20 researchers whose publications were included in the analyses. There were 94 articles, 1 review and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	95
TCS	443
MCS	4.66

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	0.88
MNJS	1.27
PP(top10%)	11%
PP(uncited)	28%
Proportion of self-citations	23%
PP(collab)	67%
PP(int collab)	55%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	8	8.25	66	1.36	1.89	25 %	0 %	19 %	50 %	13 %	52 %
2012	13	8.38	109	1.01	1.32	8 %	15 %	23 %	38 %	31 %	67 %
2013	26	6.15	160	0.88	1.45	10 %	19 %	23 %	69 %	62 %	64 %
2014	23	3.96	91	1.01	1.27	17 %	26 %	21 %	74 %	65 %	66 %
2015	25	0.68	17	0.54	0.85	4 %	56 %	47 %	80 %	64 %	73 %

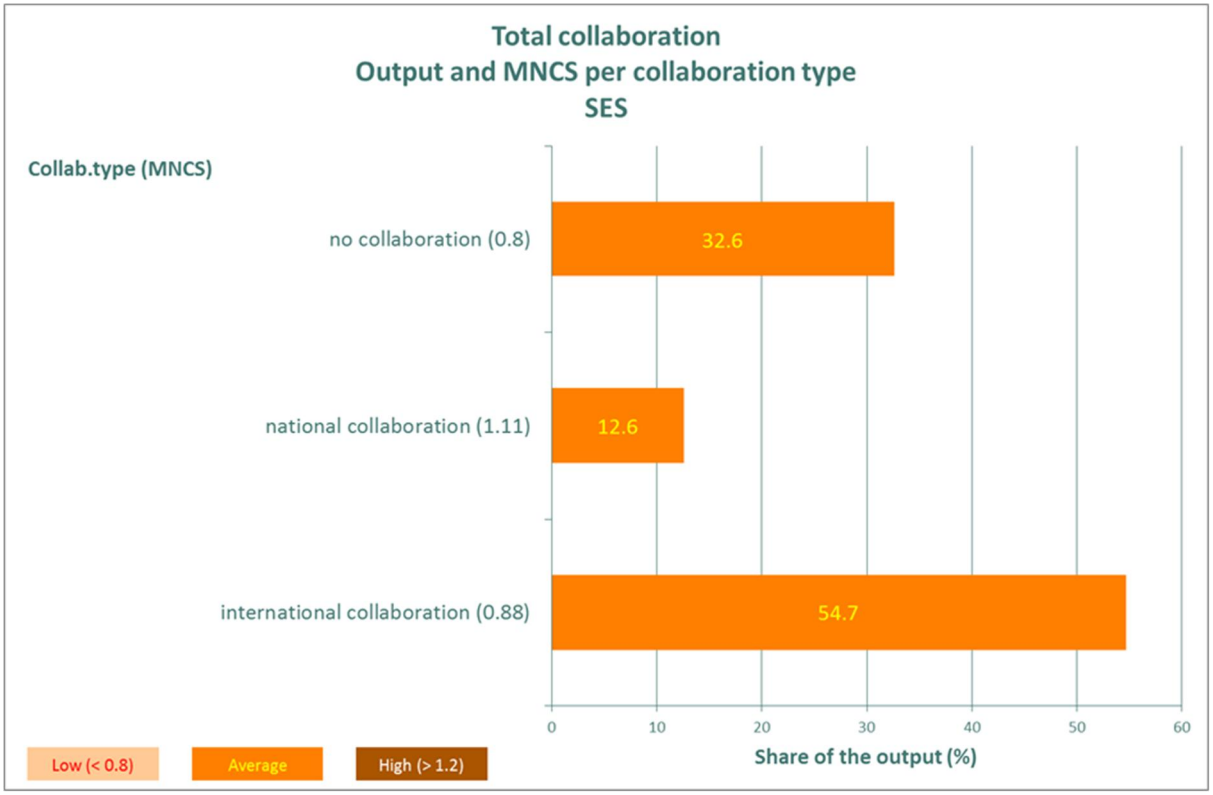


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 61%, which is considered as very good coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	262
H-index	16
TCS	1042
MCS	4.0
N-uncited	138
PP(uncited)	53%
Proportion of self-citations	31%

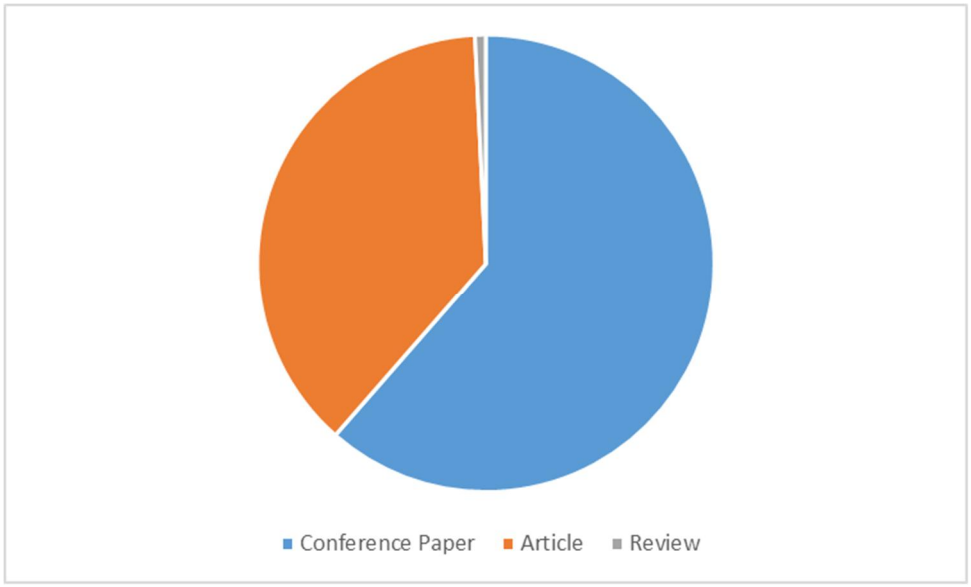


Figure 2. Publication types in Scopus dataset.

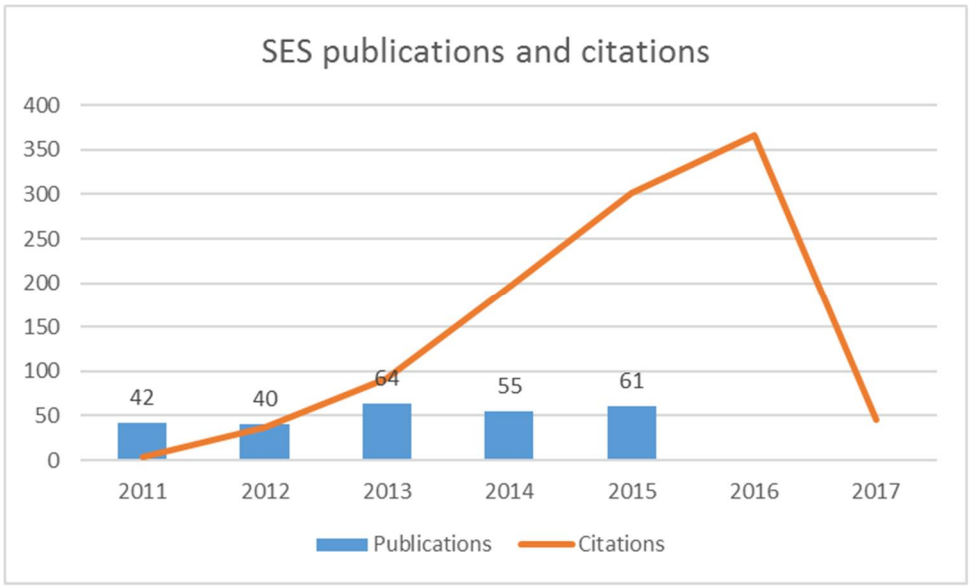


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

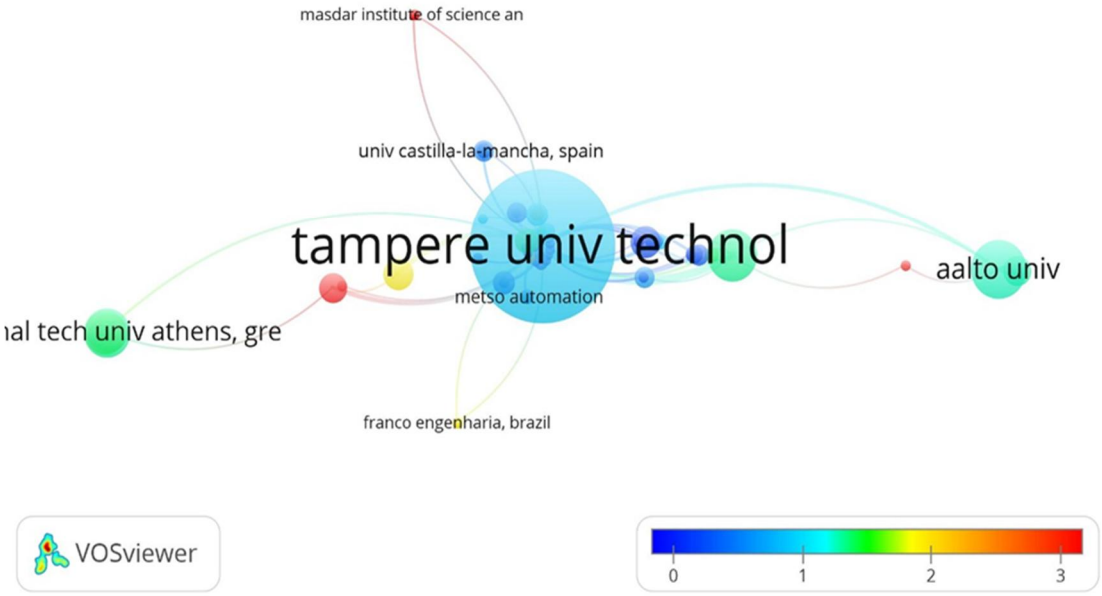


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

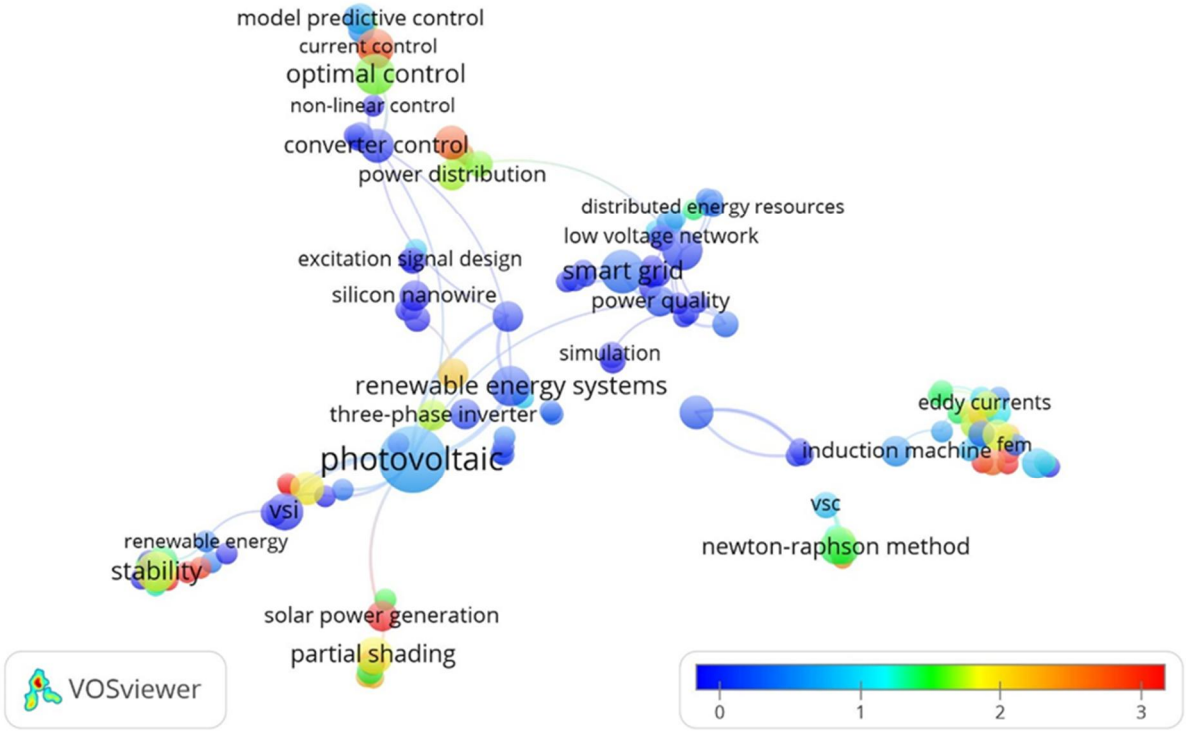
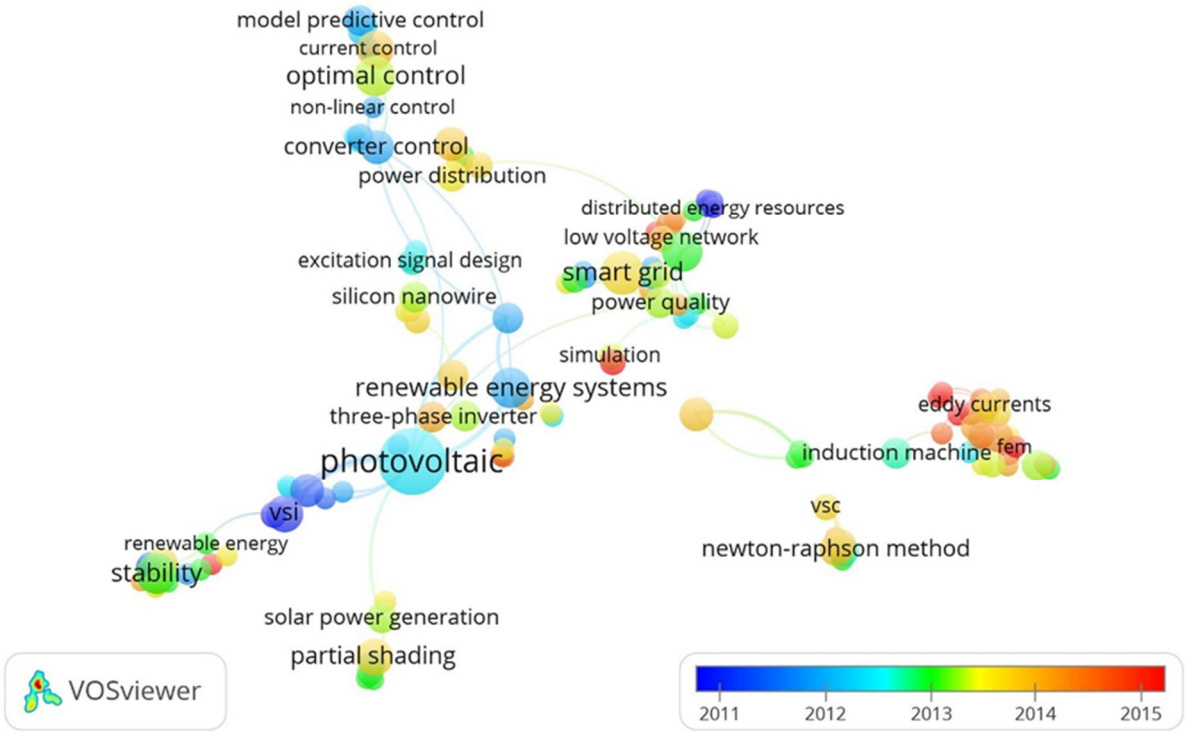


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.



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19. Urban circular bioeconomy (UrCirBio)

Head of Research Community: Jukka Rintala

Abstract

The research community (RC) for Urban Circular Bioeconomy is composed of researchers in physics, bioengineering and environmental and energy engineering. The RC studies a range of topics connected to circular economy (CE) material flows with focus on urban areas, such as production of new biofuels and biochemicals from waste products to close material cycling loops, or decipher the emissions caused by changing fuels. The aim is to improve energy- and eco-efficiency to conserve the limited resources for raw materials in the world and to reduce environmental emissions including greenhouse gas emissions. The RC members have strong ties to industry and municipalities and solid scientific track records. This research plan presents the aims of an ambitious research community that has come together recently to combine their know-how and infrastructure in a multidisciplinary unit that is able to provide CE-based solutions for industry and society.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

The work on aerosols and the biochemistry-based research (bio-based feedstocks and metal recovery) is internationally excellent. The biological (anaerobic digestion) and thermochemical energy-from-waste work is solid, and the latter seems to be of particular Finnish industrial relevance. Publications include appropriate international collaboration and are of excellent quality and notably well-cited, in a field where citation numbers tend to be low.

2. Societal relevance of research

Rating: 4

The Circular Economy as an ideal for achieving global sustainability is an exceedingly important concept. Placing this RC in a Circular Economy context is appropriate and convincing, as the research can undoubtedly contribute to development of more sustainable waste/wastewater management systems, but more could be done to tie together these research areas more closely to the circle.

3. Research environment

Rating: 3 to 4

This RC is well balanced and includes an appropriate mix of disciplines. They collaborate well nationally, internationally and with industry, but increasing these links could be emphasised for the future.

4. Potential of the Research Community

This is a well-formed, capable RC who have tied their research areas together into a credible concept and plans for the future.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 84%, which can be considered as excellent. In the research community, there were 24 researchers whose publications were included in the analyses. There were 346 articles, 24 reviews and 0 letters in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	370
TCS	3322
MCS	8.98

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.32
MNJS	1.22
PP(top10%)	11%
PP(uncited)	10%
Proportion of self-citations	26%
PP(collab)	78%
PP(int collab)	59%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(int collab)	Int. cov
2011	49	22.06	1081	1.32	1.28	7 %	2 %	20 %	57 %	37 %	88 %
2012	73	9.3	679	0.87	1.07	10 %	4 %	30 %	75 %	63 %	84 %
2013	72	8.38	603	1.26	1.13	14 %	8 %	21 %	83 %	60 %	79 %
2014	88	7.73	680	1.63	1.31	12 %	11 %	30 %	84 %	61 %	82 %
2015	88	3.17	279	1.43	1.29	12 %	20 %	35 %	83 %	66 %	88 %

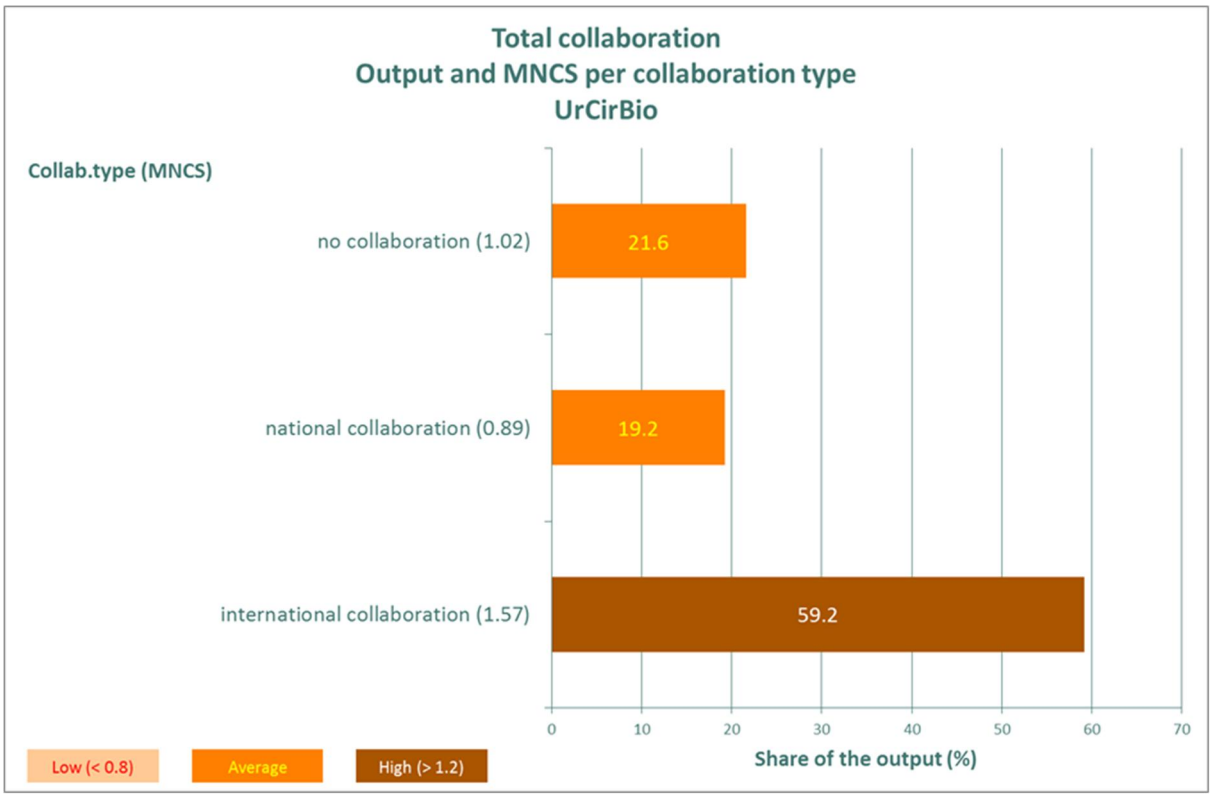


Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 81%, which is considered as excellent coverage.

Table 4. Scopus indicators

Indicator	**Performance**
P	404
H-index	25
TCS	3870
MCS	9.6
N-uncited	47
PP(uncited)	12%
Proportion of self-citations	24%

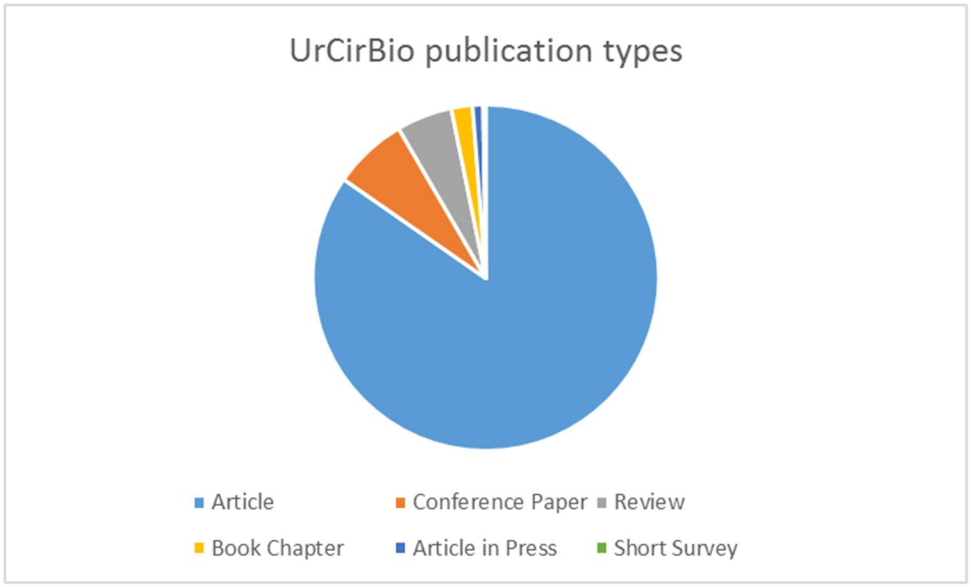


Figure 2. Publication types in Scopus dataset.

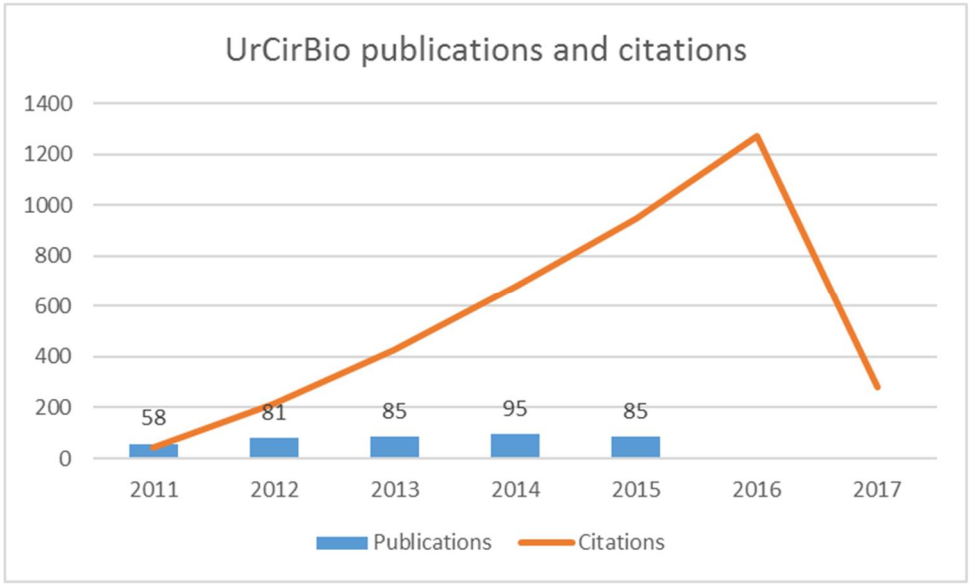


Figure 3. Trend of publications and citations in Scopus dataset (number) over the years 2011-15 with citations until February 2017.

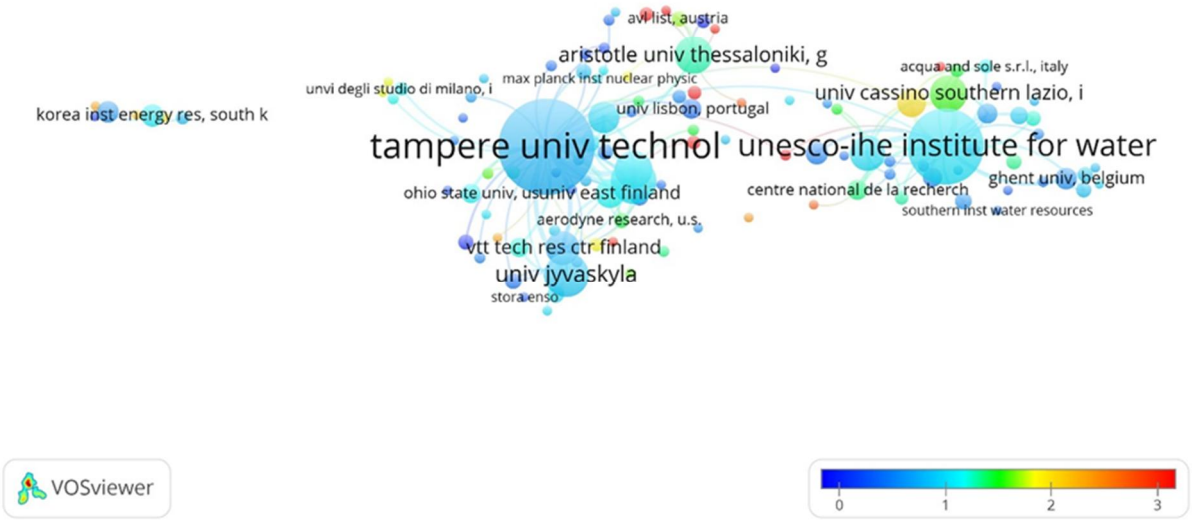


Figure 4. Co-authorship map with normalized citations. The size of the circles indicate the number of co-authored papers. The color of the collaborating organization indicates the impact of the co-authored output relative to the oeuvres expected citations score: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

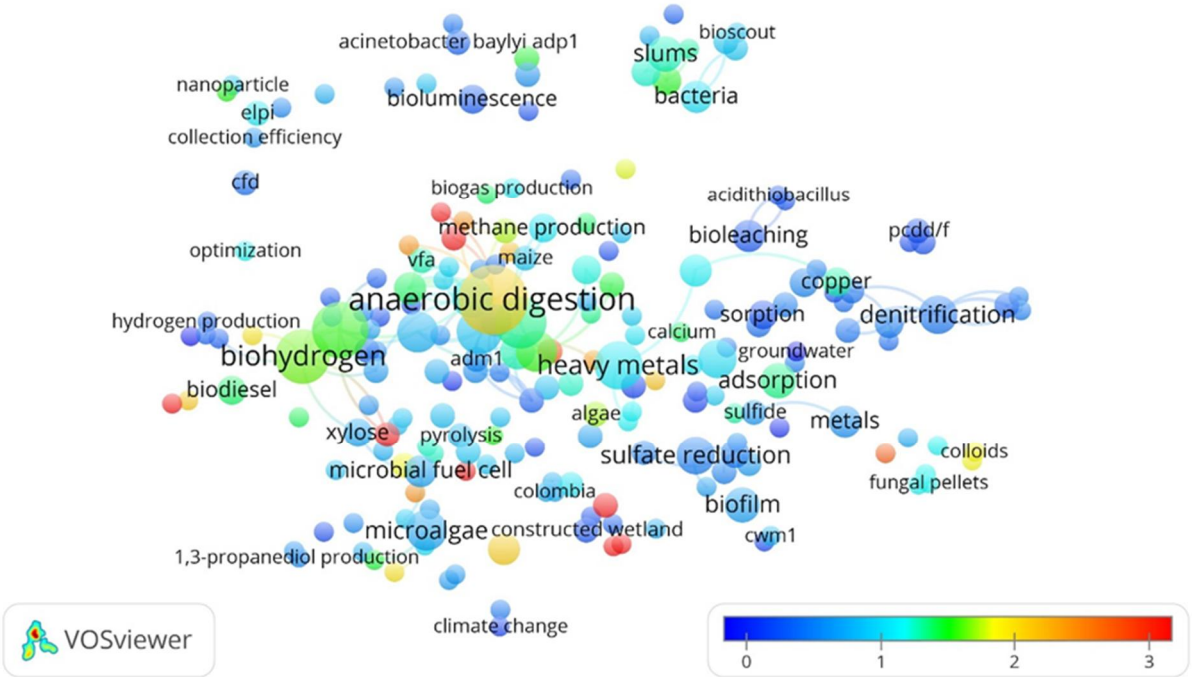


Figure 5. Research profile with normalized average citations. The size of the circles indicate the keyword occurrences. The color indicates impact: blue: impact of a university in a subject category is below average; green: impact of a university in a subject category is around average; red: impact of a university in a subject category is above average.

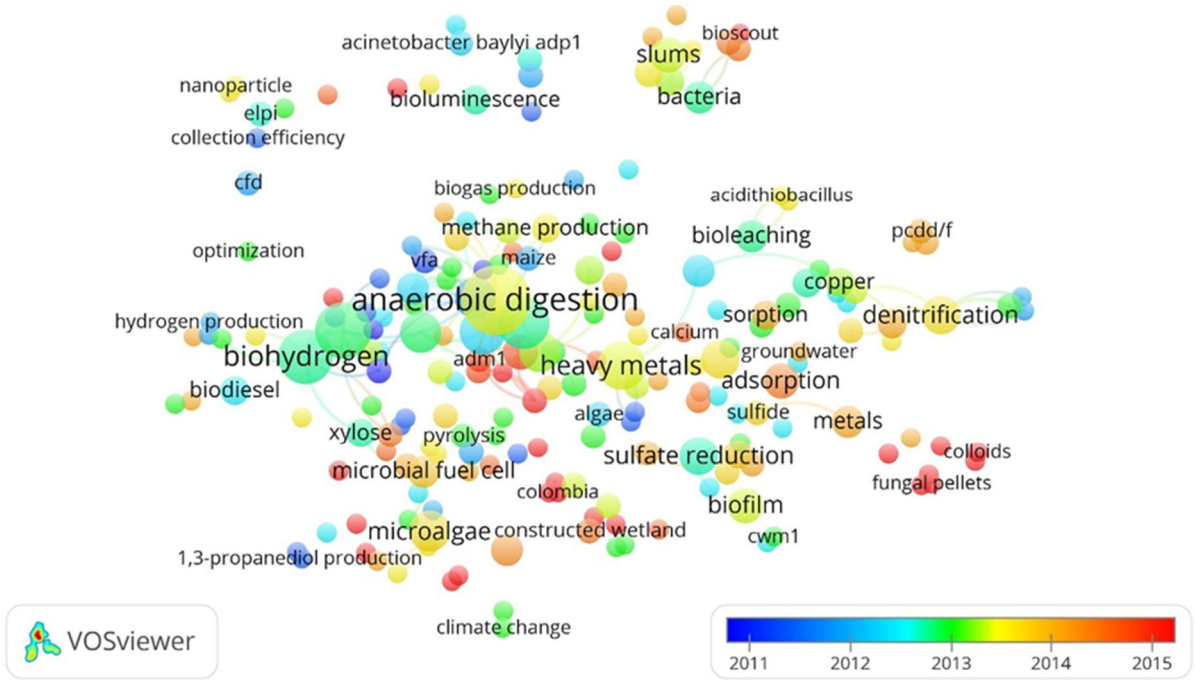


Figure 6. Research profile with the recency of research topics. The map shows the evolution of the research themes during the years 2011-15. The size of the circles indicate the keyword occurrences. The color indicates the average year of output in each cluster: blue: average year of output is 2011; green: average year of output is 2013; red: average year of output is 2015. Note that the keywords that occur during the whole period are green, because of the average measure.

20. Wireless Communications and Positioning (WICO)

Head of Research Community: Mikko Valkama

Abstract

Already now, the modern society is strongly relying on broadband data communications and corresponding communication networks and services. This covers all areas of life, personal and professional. This trend is expected to continue and expand further, through the ongoing and allencompassing digitalization process, which will eventually penetrate all industries and the whole society. This, together with the emerging Internet-of-Things (IoT) and Industrial Internet (or Industry 4.0) paradigms, raises the capacity, latency and other performance requirements of the communication networks, and wireless communications in particular, to a whole new level compared to the existing systems and solutions. More specifically, it has been recently predicted that in 2020's, there will be 200+ billion connected wireless devices which should all operate and connect smoothly to the Internet. Existing communication solutions and networks cannot support this.

Another prevailing trend in the society and industries is related to robotization and other different autonomous moving objects and machines, such as self-driving cars and drones, which also rely strongly on highly efficient and reliable wireless communications solutions. Digitalization, IoT and robotization are all areas that are also strongly connected to high-efficiency wireless positioning and localization information, both indoors and outdoors. An additional longer term aspect is related to the concept of nano-networks, e.g., in medical field, where nano-scale objects such as different implantable nano-chips and sensors communicate and network with each other. This ties in well with one of the current global mega-trends, namely health technologies, in particular in terms of seeking to provide personalized and proactive healthcare for citizens.

Stemming from the above, it is obvious that substantial investments are needed on basic research as well as more applied R&D work related to wireless communications and positioning technologies in the coming years. This is also the thematic area of this research community.

Panel report

1. Scientific ambitiousness, quality and impact

Rating: 4

The research goals of the proposal are clear and well stated. The proposal touches upon important research issues in telecommunication. Its work is quite ambitious, as it is considered to be at the forefront of telecommunication research. This research community has an impressive track record and has generated many high quality and high impact work. The problems which it aims to study are well selected in line with the current advances in the field.

2. Societal relevance of research

Rating: 5

The societal relevance is very high. The project addresses important problems at the heart of today's technology. In the era of Information and knowledge societies, communication technologies offer the means of transferring and distributing knowledge and connecting the world. They offer the means that make possible for societies to progress and make science

open to all. This research community has been heavily involved in pushing the telecommunication technologies forward by introducing new techniques and actively involving in drafting industrial standards. In addition, it has also offered tangible examples, via spinoffs, of direct exploitation of the results produced in an academic environment for the good of the wider community.

3. Research environment

Rating: 4 to 5

The research environment is excellent. The members of the community have published extensively in the top journals with the highest impact factor in the field. It is well funded and have strong links with the industries and academic institutions worldwide.

4. Potential of the Research Community

The potential of the community is very high. The topic of telecommunications and the problems that this community is addressing are crucial within the 5G paradigm and it has also started its research on the next generation telecommunication beyond 5G continue to push itself to be at the leading position of the field. The research that will be conducted can help the university to maintain its leading position in this area and ability to attracting funds and industrial collaborations.

Bibliometric report

Indicators for Web of Science data

The internal coverage for the research community is 50%, which can be considered as good. However, half of the references appear outside the coverage. Therefore, the bibliometric analyses should be considered very carefully. In the research community, there were 39 researchers whose publications were included in the analyses. There were 226 articles, 2 reviews and 1 letter in the set of publications.

Table 1. Basic Web of Science indicators

Indicator	Performance
P	228.25
TCS	1407
MCS	6.16

Table 2. Normalized Web of Science indicators

Indicator	Performance
MNCS	1.55
MNJS	1.26
PP(top10%)	18%
PP(uncited)	22%
Proportion of self-citations	20%
PP(collab)	69%
PP(int collab)	57%

Table 3. Trends of bibliometric indicators

Year	P	MCS	TCS	MNCS	MNJS	PP(top 10%)	PP(uncited)	Self-citations	PP(collab)	PP(intcollab)	Int. cov
2011	39	12.82	500	1.57	1.26	21 %	13 %	15 %	64 %	51 %	42 %
2012	31	7.23	224	1.34	0.97	15 %	19 %	16 %	45 %	39 %	40 %
2013	42	7.36	309	1.19	1.13	14 %	17 %	21 %	74 %	62 %	55 %
2014	56	4.29	240	1.54	1.55	16 %	20 %	27 %	75 %	63 %	50 %
2015	60.25	2.22	134	1.91	1.21	23 %	35 %	28 %	77 %	60 %	54 %

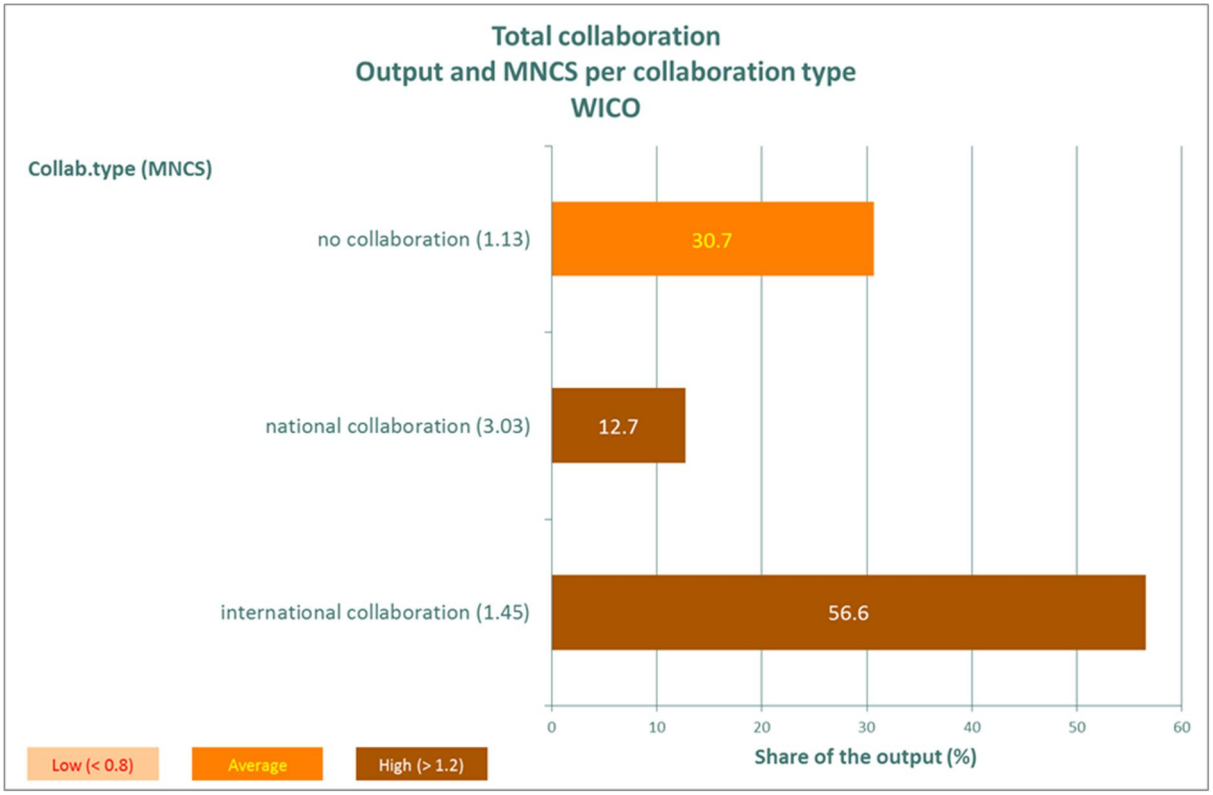


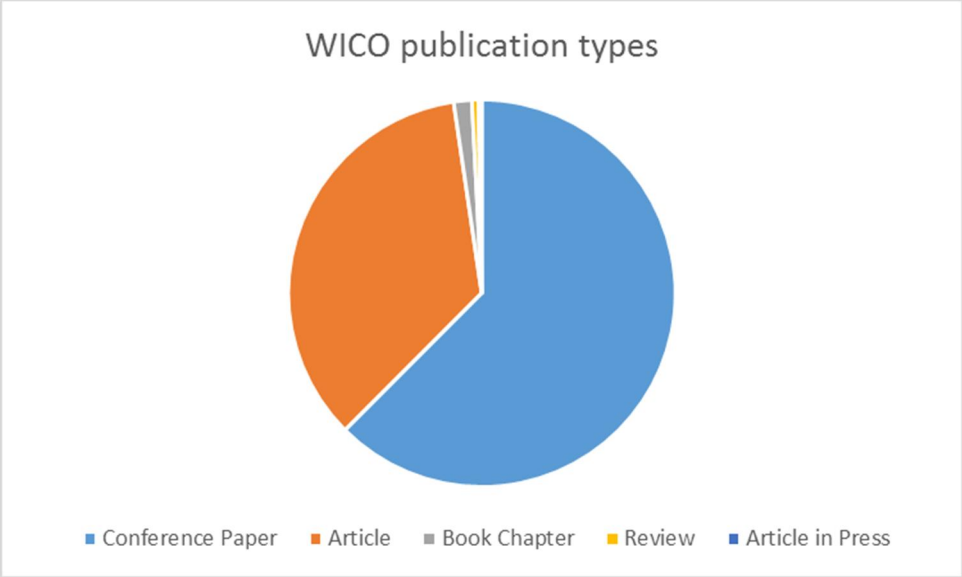
Figure 1. Collaboration profile (2011-2015/16), WoS data.

Indicators for Scopus data

Internal coverage of research community is 51%, which is considered as good coverage. However, half of the references are outside the coverage. Therefore, the bibliometric analyses should be considered very carefully.

Table 4. Scopus indicators

Indicator	**Performance**
P	728
H-index	32
TCS	4425
MCS	6.1
N-uncited	290
PP(uncited)	40%
Proportion of self-citations	25%



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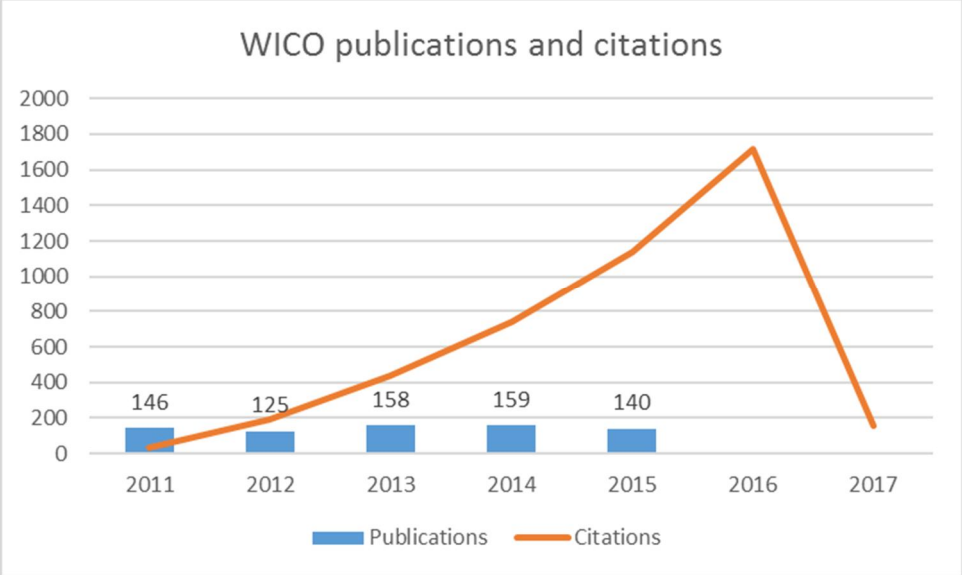

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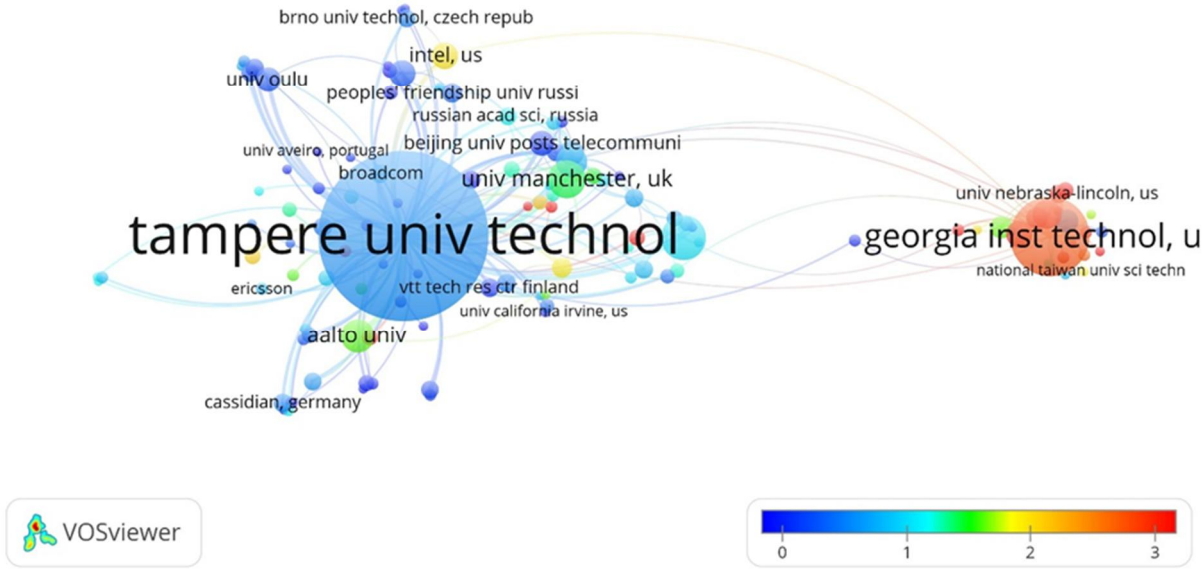

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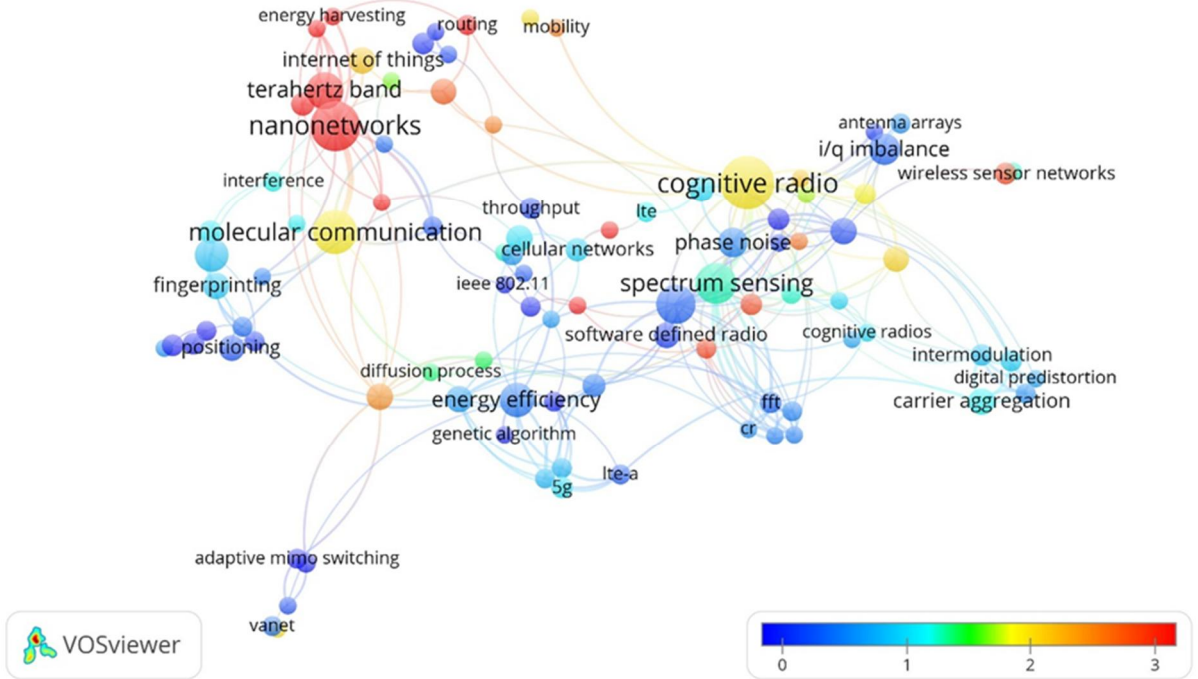

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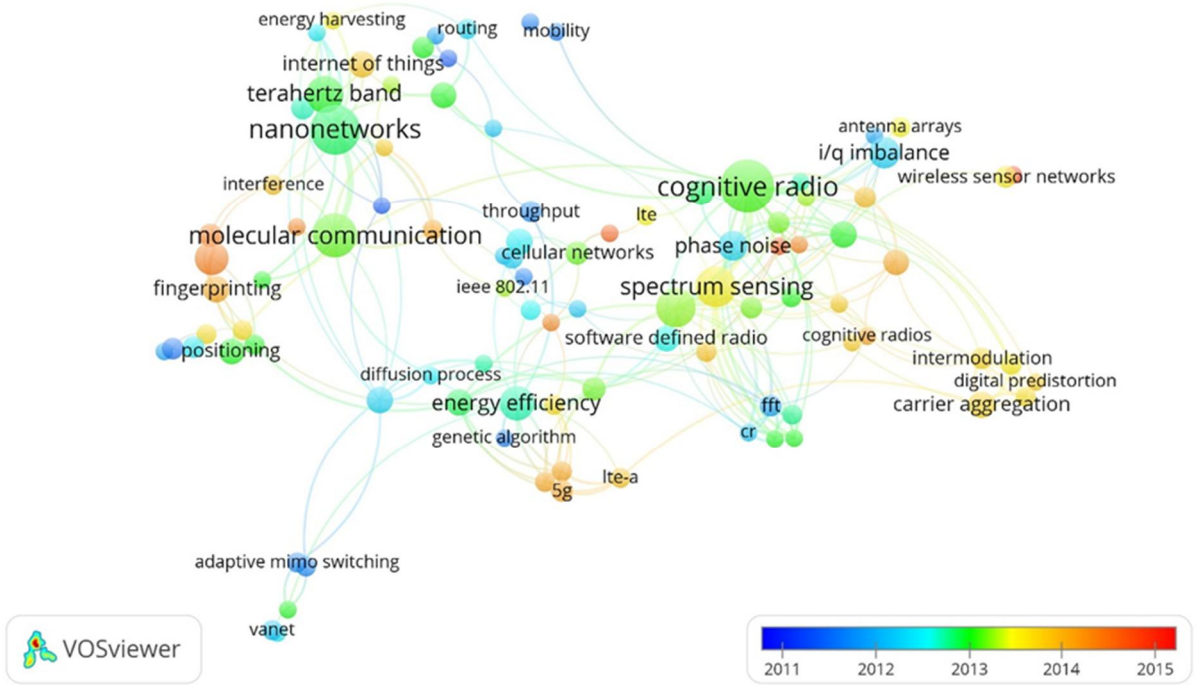

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