# Striving *for* Excellence

**Aalto University**
**Research Assessment Exercise 2009**
**and Bibliometric Analysis 2003–2007**
*Project report*

Aalto University

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***Project report***

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# President's *Greeting*

The end of the new millennium's first decade is marked by the formation of Aalto University, a merger of the Helsinki School of Economics, the University of Art and Design Helsinki and Helsinki University of Technology. According to the Charter of Foundation, the national mission of Aalto University is to sustain and improve Finland's accomplishments as an internationally competitive knowledge-based economy. Aalto University aims to contribute to and build upon all facets of Finnish society, including its economy, technology, arts and design as well as internationalisation. Moreover, Aalto University is poised to have a significant global impact as it seeks to promote the welfare of humankind and the environment. Aalto University will fulfil its ambition to become a world class research university by cultivating its research and education to comply with the highest international standards.

To help in reaching these ambitious goals, Aalto University carried out the Research Assessment Exercise 2009 and the Bibliometric Analysis 2003–2007. The results of these exercises are summarised in this report, forming a solid basis for the strategic planning of Aalto University's research agenda and research practices.

There is a well-known saying in Finnish: To acknowledge the facts is the beginning of wisdom. I am confident that the contents of this report mark the beginnings of our extraordinary path to research excellence at Aalto University.

Otaniemi, November 2009

**Professor Tuula Teeri**
President of Aalto University

# Preface

The creation of Aalto University offered an ideal opportunity to evaluate the entire research base of the three universities forming the new university. The aims of the evaluation process were to analyse the quality profiles of the research activities of the Aalto University units by identifying their present strengths and future potential, as well as to provide suggestions and recommendations on how to promote and achieve excellence.

A comprehensive research evaluation at this point of time would be extremely useful in setting the research agenda for the new university. The evaluation process was, accordingly, designed to support the assessed units in the task of improving the quality and impact of their research and initiating a university-wide strategic process, which will deal with the future direction of research at the Units of Assessment. Thus, the evaluation project was designed to be a development activity, and the results will form a reference point for future research assessments.

The Aalto University research evaluation project consists of two parts: the Aalto University Research Assessment Exercise 2009 and the Aalto University Bibliometric Analysis 2003–2007. This report introduces the two evaluation approaches and summarises the results. The results are presented first at the level of Aalto University and then at the level of the Units of Assessment. The section on each Unit of Assessment includes a short introduction to the unit based mainly on the unit's Self Assessment Report, a summary of the Panel Assessment and, finally, some observations based on the results of the Bibliometric Analysis. The conclusions concerning both the assessment process and the quality of research at Aalto University are presented in the final chapter.

The assessment exercises were very ambitious, especially because new elements were introduced to the assessment process and to the assessment criteria. In addition, the time schedule of the process was challenging. However, we as the assessment organisers are confident that the main objectives of the exercises were accomplished and that the results reported here will prove invaluable in the development of Aalto University.

On behalf of the Assessment Organisation

**Professor Outi Krause**
Chair of the RAE Working Group

# Executive *Summary*

The Aalto University research evaluation project consisted of two parts: the Aalto University Research Assessment Exercise 2009 and the Aalto University Bibliometric Analysis 2003–2007. The Research Assessment Exercise was conducted as a peer-review assessment by nine international panels with 62 highly esteemed experts. Altogether the research of 46 units (departments, institutes or equivalent entities) was assessed and the results were published in September 2009. The Bibliometric Analysis was performed by an external expert and it was based on the data collected from the ISI Web of Science for the Research Assessment Exercise.

This report summarises the results of the two projects and presents the results both at the Aalto University level as well as at the level of Units of Assessment. In most cases, the two methods of evaluating the units point clearly in the same direction. The methods are complementary to each other in constructive ways, thus offering a deeper understanding than if only one or the other of the methods had been applied. However, it should be noted that, due to the small number of ISI Web of Science indexed articles at some Units of Assessment, the Bibliometric Analysis 2003–2007 does not apply to these units.

The findings of the Research Assessment Exercise suggest that the most distinctive strength of research at Aalto University is the level of its societal impact in general, and its interaction and cooperation with industry in particular.

In general, Aalto University's research is of high international quality. The Bibliometric Analysis reveals the field-normalised citation score for the whole University to be significantly (23%) above the world average. According to the Research Assessment Exercise, many units reach outstanding quality, with some units described as world-leaders in their own subfields.

However, it is also clear that the high research quality in Aalto University – as assessed by the Expert Panels – does not always translate to high scientific impact on the international scientific community. Indeed, according to the evaluation, parts of the Aalto University research community may underestimate the importance of international and high-

quality dissemination of their research.

There are many structural challenges facing Aalto University's research prospects in the future. To become a world-class research institution, Aalto University needs to replace its current opportunity-driven culture with a strategy-driven culture. To promote that necessary change in the research culture, the Research Assessment Exercise highlights the following steps which are of utmost importance and urgency:

- An internationally comparable tenure-track system should be established for academic faculty.
- Rapid internationalisation of the research environment should have a high priority, with strong emphasis on international recruitment and increased international faculty exchanges.
- The role of long-term and high-risk basic research in Aalto University should be enhanced.
- Academic leadership should be fostered and long-term strategic planning strengthened across the university.
- All professors should be encouraged and required to carry out research, including practice-based research, and to contribute to the research culture and outputs at Aalto University.
- Publishing in high-impact journals and through leading international publishers should be strongly encouraged.

# 1. Background

The new University Act legislated by the Finnish Parliament in June 2009 marks the beginning of a major reformation of the Finnish university system. Although the new legislation grants the universities much more autonomy, the Finnish government will still be the universities' main source of revenue. Nonetheless, a new funding model needs to be developed, and it is expected that the new model will place more emphasis on strategic issues rather than current quantitative measures, such as the number of students enrolled and graduated. This implies that quality measures of both research and education will be of more importance in the funding model. The basic principle of the universities will be to provide higher education based on its own cutting-edge research. Yet one key question facing universities is what these quality indicators should be.

**University Rankings**

Global university rankings have increased in importance within the academic community making it increasingly difficult for universities to ignore or neglect them. The public and private sectors readily compare universities on the global ranking lists when seeking out global partnerships with universities. Moreover, prospective students also use the lists when determining which universities they will attend.

The two most cited university rankings are The Academic Ranking of World Universities of Shanghai Jiao Tong University and the Times Higher Education-QS World University Ranking (THE-QS). The Shanghai Jiao Tong ranking compares 1200 higher education institutions worldwide according to indicators that comprise of alumni winning Nobel Prizes and Fields Medals (10%), staff winning Nobel Prizes and Fields Medals (20%), highly-cited researchers in 21 broad subject categories (20%), articles published in *Nature* and *Science* (20%), the Science Citation Index and Social Sciences Citation Index (20%) and the per capita academic performance (on the indicators above) of an institution (10%).[1] THE-QS ranks the "Top 200

1 www.arwu.org/Methodology2009.jsp

World Universities," with its rankings also broken down into subject and region. The ranking weights are: Peer Review Score (40%), Recruiter Review (10%), International Faculty Score (5%), International Students Score (5%), Faculty/Student Score (20%) and Citations/Faculty Score (20%).[2]

Finnish universities consistently rank quite low, or not even at all, in these global university rankings. In the Shanghai ranking, the University of Helsinki has ranked between the 68th and 74th positions. Helsinki University of Technology (TKK) has previously ranked between 400th and 500th, but in the latest 2009 ranking, TKK did not make it into the top 500. On the THE-QS rankings 2009 of engineering and technology, TKK ranked 94th globally. Among the European universities (EU27 and Switzerland), TKK ranked 24th, while in comparison, the Royal Institute of Technology Stockholm (KTH) was 11th, and the Technical University of Denmark (DTU) was 20th.

European Business school rankings are published by the *Financial Times*. Its ranking methodology is largely based on schools' business programmes and the salaries of their alumni. In 2008, the Helsinki School of Economics (HSE) held the 17th position, while the Stockholm School of Economics was 15th, and the Copenhagen Business School ranked 37th.[3] The *Financial Times* rankings are only applicable for business schools, and research indicators play only a minor role in its methodology.

In addition to these rankings, an equally, if not more important measure for business schools is the ability to attain international accreditation through reputable institutions assessing quality. Although the main focus for accreditation is largely based on the quality of business education, quality of research plays an important role as well. HSE is accredited by three major international organisations that certify business schools (AACSB, AMBA and EQUIS).

To the best knowledge of the authors of this report, no comparable international rankings of art and design universities have been published.

In addition to measures and statistics which characterise e.g. the size of a university, one key element in the rankings should be research quality. Typically, only peer-reviewed scientific publications and citations collected from international databases are measured. For example, Shanghai Jiao Tong uses the Science Citation Index and Social Sciences Citation Index, whereas THE-QS uses Scopus. While this methodology will continue to be an important indicator of research quality, there is a crucial need for a more qualitative understanding of university research. Although several indexes based on bibliometric data have been developed, there is no general methodology which has been widely accepted by the international academic community.

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2 www.topuniversities.com/university-rankings/world-university-rankings/methodology/simple-overview

3 http://rankings.ft.com/businessschoolrankings/european-business-school-rankings

## Research Assessments at Finnish Universities

As noted, there are limits on the value of global rankings and other assessments which are solely based on publications and bibliometric data. One commonly used method to assess research quality is to assemble international peer-review panels. This process usually entails inviting a group of highly esteemed experts to either assess the research quality of the whole university as one entity, or of small units, like departments or research groups.

During the past decade, several Finnish universities, including universities of Helsinki, Joensuu, Jyväskylä, Kuopio, Oulu and Tampere, have carried out research assessment exercises. The assessments of research of the three universities which will merge into Aalto University have not extensively been done. In 2006 the Department of Civil Engineering at TKK was assessed as a pilot exercise for the assessment of the whole university. This assessment followed the methods used in the other Finnish universities. In addition, teaching was also partly included in the process.

In addition to the universities, the Academy of Finland conducts evaluations of disciplines and research fields in Finland. During the last few years, the Research Councils of the Academy have commissioned evaluations of mechanical engineering research, energy research, computer science research and, very recently, evaluation of arts research. Several research units of Aalto University have been included in these evaluations which have produced valuable information about present research quality and proposals for further development.

# 2. Aalto University *Research Assessment* Exercise 2009

## Introduction

The creation of Aalto University, a merger of the Helsinki School of Economics (HSE), the University of Art and Design Helsinki (TaiK) and Helsinki University of Technology (TKK), was a perfect moment for arranging a comprehensive research evaluation. The objectives of the assessment exercise were to analyse the quality profiles of the research activities of the Aalto University units by identifying their present strengths and future potential, and to provide suggestions and recommendations on how to promote and reach excellence. The objectives are described in detail in the "Terms of Reference for Research Assessment Panels" document available at the Aalto University website.[4]

The three universities forming Aalto University represent mainly applied disciplines, and traditionally the major part of the activities of these universities have focused largely on high-quality practice and on educating well-respected professionals for the service of the Finnish society. The transition at the level of the whole university from a predominantly teaching institution to combining research and teaching is a relatively recent development at the three universities.

As indicators for the mentioned change the number of publications in journals listed in the ISI Web of Science database,[5] and the number of citations received by these articles, by researchers affiliated with HSE, TaiK

4 www.aalto.fi/aaltorae

5 ISI Web of Science as used in this report refers to the Thomson Reuters bibliographic database service Web of Knowledge (formerly Thomson Scientific, formerly Institute for Scientific Information) which hosts the databases Science Citation Index Expanded, Social Science Citation Index and Arts & Humanities Citation Index, and which is generally known as ISI Web of Science or simply as ISI.

and TKK, respectively, from 1995 onwards are presented in Figures 2.1, 2.2 and 2.3. The figures show that e.g. HSE has truly entered the international research community around the turn of the millennium, and the impact of HSE's research outputs on the international research community, as measured by the number of citations, is still steadily growing. TKK's figures show a similar development for the citation impact, while the production of articles in ISI-listed journals has a longer history at TKK. These figures are not that relevant for TaiK, since publications in ISI journals do not form an important channel for disseminating research results for TaiK's disciplines in a manner comparable to HSE and TKK (hence the small number of publications). However, the citations received by TaiK's few ISI publications during the last 7 years form a growth pattern with by now a familiar shape. This shows evidence of the steadily increasing impact of TaiK's research on the international scientific community also when measured in terms of ISI citations.

Figures 2.1–2.3 suggest that the transition from characteristically teaching organisations that imported novel innovations to Finland into research-oriented institutions that do not only apply research-based ideas but also produce new knowledge and innovations for the international research community has been successful at the three universities forming Aalto University. Moreover, the figures show that the international impact and visibility of Aalto University's research is currently growing strongly both in the field of technology, business studies and art and design.

This very moment, when Aalto University's research has reached a solid international orientation and impact with a clear forward trajectory, is an ideal time for ensuring that the Aalto University research staff knows how to direct their research efforts so that this fine development will not stop until Aalto University has reached the true world class in the quality and impact of its research. This is the process that the Aalto University research evaluation project was designed to support.

During the preparation of the Aalto University Research Assessment Exercise, new elements were introduced into the assessment process and criteria compared to those previously used in the assessments of Finnish universities. The most important of these elements was that in addition to the quality of research the Expert Panels were asked to evaluate impact of research in two distinct parts: scientific and societal. Additionally, all panels were invited to site visits at the same time. This solution follows the example of KTH, where the interactions between Panel Chairs were considered to be useful and constructive.

In the self-assessment phase of the assessment, each unit was asked to report its own views about the assessment criteria, including its most important research achievements, an understanding of the scientific and societal impact of its own research, as well as its research environment and future potential. These Self-Assessment Reports were included in the material packages prepared for the Assessment Panels. It was also strongly emphasised that the Self-Assessment Report is one of the best ways for a

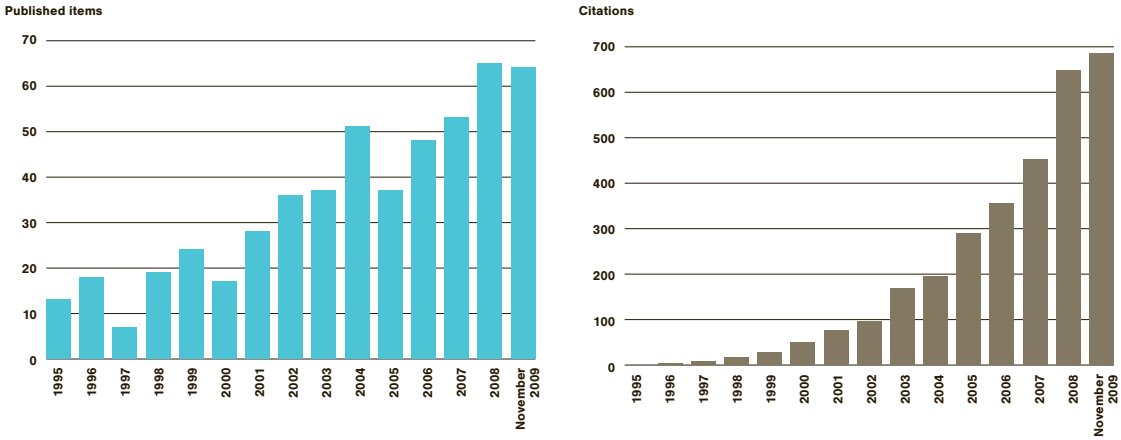


**Figure 2.1** Number of published items (ISI database) at the Helsinki School of Economics during 1995–2009 and number of citations until November 2009.

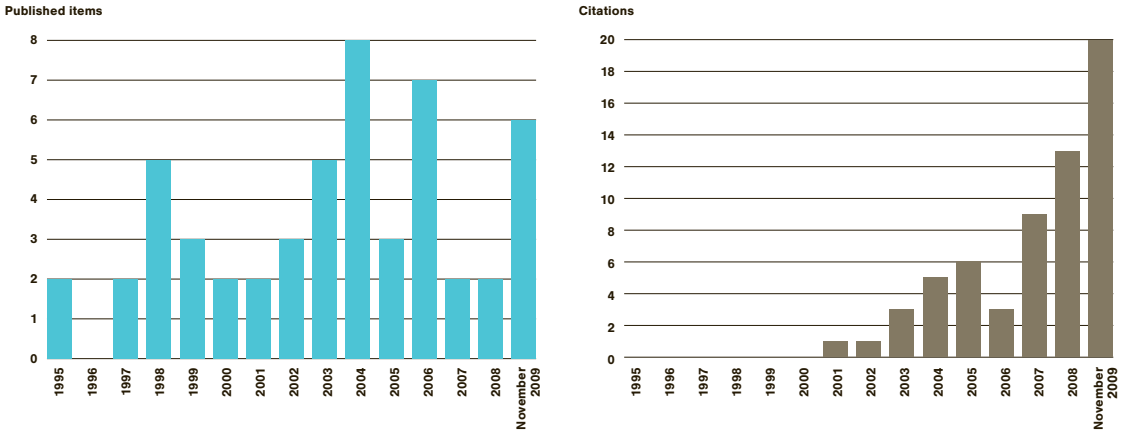


**Figure 2.2** Number of published items (ISI database) at the University of Art and Design Helsinki during 1995–2009 and number of citations until November 2009.

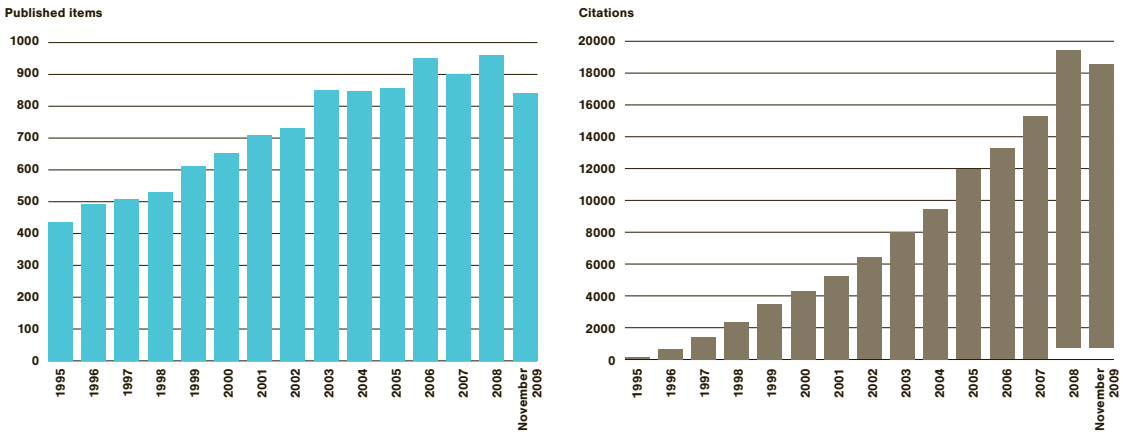


**Figure 2.3** Number of published items (ISI database) at Helsinki University of Technology during 1995–2009 and number of citations until November 2009.

unit to contribute its own views on how to develop its research agenda, and bring it to the attention of the Aalto University management.

## Assessment Organisation

The Rectors of the Helsinki School of Economics (HSE), the University of Art and Design Helsinki (TaiK) and Helsinki University of Technology (TKK) initiated the preparation of the Aalto University Research Assessment Exercise (RAE) in early 2008. In the summer of 2008 the Rectors appointed a Working Group to support the practical execution of the assessment and a Project Manager to coordinate the assessment exercise. TKK's Vice-Rector for Research, Professor Outi Krause was chosen to chair the Working Group and to head the assessment preparations.

The Working Group consisted originally of the Vice-Rectors for Research of the three universities and a senior professor from each university. When HSE's Vice-Rector, Professor Timo Saarinen took up another key position in the Aalto University transition process, he was replaced in the Working Group by Professor Pekka Korhonen. The Rectors also invited Professor Yves Doz to join the working group as a special advisor to bring an international perspective to the assessment preparations. The Assessment Organisation was later completed by appointing an Assessment Coordinator to coordinate the practical execution of the project and school-level coordinators to administer the collection of the assessment materials at HSE, TaiK and TKK.

In September 2008 the Board of Trustees of the Aalto University Foundation consolidated the role of the assessment as part of the creation process of Aalto University and appointed a Steering Committee to oversee and manage the assessment. Vice-Rector, Professor Tuula Teeri from KTH Royal Institute of Technology was a member of the Steering Group from the beginning. When she was chosen to become the first President of Aalto University, she continued as an advisor to the Steering Group.

Information specialists at TKK's library carried out a major piece of work in checking the publication information of all the researchers counted as research active staff at the assessment and in creating the online Aalto RAE publication database that included the publication information of all the research active staff. The efforts at the library were coordinated by Ms. Irma Pasanen and the technical construction of the database was accomplished by Mr. Jukka Lehmus.

Finally, the staff at the Units of Assessment dedicated much of their time for providing the assessment materials and for arranging the site visits of the panels. Each unit was asked to appoint a contact person via whom all the information concerning the assessment process was to be distributed to the unit. At the site visit week the Assessment Panels were accompanied and assisted by nine student guides who received unanimous praise for their enthusiasm from the Assessment Panels.

The Assessment Organisation is introduced below.

## Steering Committee

**Professor Marja Makarow**,
Board of Trustees, the Aalto University Foundation, Chair
**Professor Emeritus Jarl-Thure Eriksson,**
the Tampere University of Technology
**President, Dr. Mikko Kosonen,** the Finnish Innovation Fund Sitra
**Professor Arto Mustajoki,** the University of Helsinki

## Special Advisor

**Professor Tuula Teeri,** Vice-Rector,
KTH Royal Institute of Technology Stockholm (until 31 March 2009),
President of Aalto University, 1 April 2009 onwards.

## Working Group

**Professor Outi Krause,** Vice-Rector, TKK, Chair
**Professor Matti Keloharju,** HSE
**Professor Pekka Korhonen,** HSE
**Professor Pekka Korvenmaa,** Vice-Rector, TaiK
**Professor Yrjänä Levanto,** TaiK
**Professor Mikko Paalanen,** TKK

## Special Advisor

**Professor Yves Doz**, HSE & INSEAD

## Project Manager, Secretary for the Steering Committee and the Working Group

**Dr. Antti Saaristo,** HSE

## Aalto University Research Assessment Coordinator

**Ms. Katri Lehtovaara**

## School-level Research Assessment Coordinators

**HSE: Ms. Selja Susiluoto**
**TaiK: Ms. Pia Sivenius**
**TKK: Ms. Anita Rautamäki**

## TKK Library Assessment Coordinators

**Mr. Jukka Lehmus**
**Ms. Irma Pasanen**

## Execution of the Assessment

In the Aalto University Research Assessment Exercise 2009 nine panels consisting of 62 international experts assessed the research of 46 units (academic departments, research institutes or equivalent entities) at HSE, TaiK and TKK during the assessment period from 1 January 2003 until 31 December 2008. The Assessment Panels are introduced in the Appendix.

All the panel members signed a declaration of the lack of conflict of interest stating that the panellist in question does not have any conflict of interest in the assessment exercise: the panellist in question is not, and has not been during the assessment period, engaged in joint research projects with the researchers of the unit he or she evaluated and has not published joint publications with them during the assessment period. The panel members were paid an expert fee by HSE, TaiK and TKK.

The panels based their assessments on the material provided by the assessment organisation and on interviews conducted during the site visit week in Finland. The background, objectives and criteria applied in the assessment as well as the assessment's working arrangements are introduced in the "Terms of Reference for Research Assessment Panels" document that guided the Assessment Panels in their evaluation work.[6]

The assessment materials provided to the Assessment Panels consisted of:

- A short introduction to the Finnish higher education system and related issues.
- Rectors' introductions to the research strategies of HSE, TaiK and TKK.
- "Terms of Reference for Research Assessment Panels".
- "Instructions for Strategic Self-Assessment for the Units of Assessment".
- "Instructions for Mapping of Staff for the Units of Assessment".
- Self-Assessment Reports of the units covered by the panel.
- Instructions on how to use the online Aalto RAE database that lists the main research outputs and other scientific activities of the unit's research active staff and includes, when applicable, links to the main publications.

The animating idea behind the self-assessments was to give each unit an opportunity to explain the particular understanding of research excellence and research practices in the unit's own field of research and to allow the units to make their own case regarding all the aspects that the panels were asked to assess. The Units of Assessment were allowed to submit evidence

6 "Terms of Reference for Research Assessment Panels" document is available at Aalto University website at www.aalto.fi/aaltorae.

of the research achievements by only those individuals who belonged to the research active staff of the unit in question on the assessment census date of 1 October 2008.

The Self-Assessment Report of each unit included:

- The list of research active staff at the unit on the Aalto RAE census date.
- Details of the unit's budgetary and external funding during the assessment period.
- A maximum of two page description of the unit's history and present research profile.
- A maximum of two page description of the unit's approach to scientific research and a list of unit's main research achievements during the assessment period.
- A maximum of two page description of the scientific impact of the unit's research during the assessment period.
- A maximum of two page description of the societal impact of the unit's research during the assessment period.
- A maximum of two page description of the research environment at the unit.
- A maximum of two page assessment of the future potential of the unit.
- A maximum of two page SWOT-analysis of the unit's research activities and environment.
- Short curricula vitae of the unit's professors.

Hence, the Assessment Panels had access to an extensive amount of information concerning the research inputs and outputs of the Units of Assessment. However, the panels had access neither to the Aalto University Bibliometric Analysis nor to its results. Thus, the peer-review reports are not influenced by the analysis.

The Expert Panels visited HSE, TaiK and TKK between 7 and 12 June 2009. The visit to each Unit of Assessment included a short introduction to the unit and separate interviews with representatives of the unit's (i) professors, (ii) other researchers, and (iii) doctoral students. In some smaller units the separate interviews were replaced by a discussion between the panel and representatives of the research active staff of the unit.

The panels were asked to provide a separate assessment report on each Unit of Assessment covered by the panel. The assessment reports consisted of (i) a general statement concerning the Unit of Assessment, (ii) a statement concerning the relation between the research profile of the Unit of Assessment and the general research strategy of the unit's home university, (iii) numerical ratings and written statements concerning the scientific quality, scientific impact, societal impact, environment and future potential of research at the unit, and (iv) the panel's recommendations for the future. The panels wrote the first versions of their assessment reports during the site visit week and the Panel Chairs submitted the final reports

two weeks after the visit. The full Panel Reports are available at the Aalto University website.[7]

The panels were asked to apply in their Assessment Reports the rating scale shown in Table 2.1.

**Table 2.1** The numerical rating scale applied in the Assessment.

| | In the case of the future potential only: |
|---|---|
| 5 Outstanding International Level | 5 Outstanding |
| 4 Very Good International Level | 4 Very Good |
| 3 Good International Level | 3 Good |
| 2 Fair International Level | 2 Fair |
| 1 Emerging International Level | 1 Weak |

The word "international" indicates that each Unit of Assessment was compared internationally with established research units in the unit's own field of research. Detailed instructions on how to apply the rating scale on different aspects of the assessment were given in the "Terms of Reference for Research Assessment Panels" document. Since the Aalto University Research Assessment Exercise 2009 was essentially a developing exercise with a forward-looking emphasis, the panels were very strongly instructed to focus on the written statements motivating the numerical ratings and on their recommendations for the future. The numerical rating scale was therefore mainly a tool the panel could use in its internal discussions.

## Mapping of Staff for Aalto RAE

In the Aalto RAE census the staff at the Units of Assessment on 1 October 2008 was counted and divided into 7 categories as represented in the Figure 2.4. The total number of staff in the census was 3041 individuals (325 at HSE, 336 at TaiK and 2380 at TKK). This includes only the staff working at the Units of Assessment, excluding thus the personnel of the schools' central administration and other non-research units. The units were allowed and required to report the research achievements and outputs of the research active staff, which consists of senior researchers, postdoctoral research staff, other research staff and, in accordance with the Finnish university research tradition, doctoral students. The data concerning the activities

7 www.aalto.fi/aaltorae

and outputs of individuals counted as members of research active staff in the Aalto RAE mapping of staff was used as the basis of both the Panel Assessments and the Bibliometric Analysis. At HSE and TKK, the research active staff comprises approximately 80% of the total staff at the Units of Assessment, while at TaiK the coverage is approximately 40%.

The exact definitions of senior research staff, postdoctoral research staff, other research staff and doctoral students are described in the "Instructions for Strategic Self-Assessment for the Units of Assessment" document, but roughly these categories were defined as follows:[8]

- Senior Research Staff include professors, academy fellows and researchers whose doctoral degree is awarded before the year 2003.
- Postdoctoral Research Staff include researchers who do not belong to the Senior Research Staff on the basis of the position they hold at the unit and whose doctoral degree is awarded after the year 2002.
- Other Research Staff include researchers without a doctoral degree and who neither pursue doctoral studies at their unit on full-time basis nor belong to the Senior Research Staff on the basis of the position they hold at the unit.
- Doctoral Students include individuals who pursue doctoral studies on full-time basis at the unit and who do not belong to the Senior Research Staff on the basis of the position they hold at the unit.

The low proportion of research active staff at TaiK's Units of Assessment and TKK's Department of Architecture is partly explained by the fact that the professors and other members of academic staff whose job requirements do not contain a research element and who have been employed on the basis of their artistic merits (rather than on the basis of conventional research merits) were excluded from the mapping of research active staff. Such staff members were counted as belonging to the teaching staff and, accordingly, their achievements and outputs were not included in the Aalto RAE. With hindsight this seems somewhat unfortunate, for it entails that the artistic or practice-led activity, which is characteristic for these individuals and especially for TaiK's units, was not represented in the assessment exercise as well as it would have deserved.

Figure 2.4 indicates that by constituting on average approximately half of the research active staff, doctoral students played a rather large role in the RAE and the bibliometric analysis. Moreover, it should be noted that the Units of Assessment were asked to report in the mapping of staff only those doctoral students that the unit considers to be pursuing doctoral studies on a full-time basis at the unit. Table 2.2 shows that the mapping of staff reached roughly only one third of the total number of doctoral students. The achievements of

8 "Instructions for Strategic Self-Assessment for the Units of Assessment" document is available at Aalto University web site at www.aalto.fi/aaltorae.

the doctoral students (or lack thereof) not included in the mapping of staff remain invisible both in the RAE and the bibliometric analysis.

**Table 2.2** Number of Doctoral Students.

| | RAE Mapping of Staff | Total Number in 2008 | RAE coverage |
|---|---|---|---|
| HSE | 101 | 250 | 40% |
| TaiK | 56 | 202 | 28% |
| TKK | 902 | 2700 | 33% |

## Funding Details as Reported in Aalto RAE

During the assessment period 2003–2008, the average annual total funding of HSE's Units of Assessment taken together was a little less than 14 million euros, while the same figure for TaiK's Units of Assessment was approximately 20 million euros and for TKK's Units of Assessment approximately 170 million euros. As with the mapping of staff, these figures concern only the funding of the Units of Assessment and do not contain the expenses of central administration and other non-research units. As can be seen in Figure 2.5, at TKK only approximately 40% of the total funding of the Units of Assessment comes from the State budget funding, and the rest is obtained from external sources. At HSE the State budget funding covers approximately two thirds of the overall expenditure of the Units of Assessment, while at TaiK the State budget funding is responsible for approximately 90% of the total funding of the Units of Assessment.

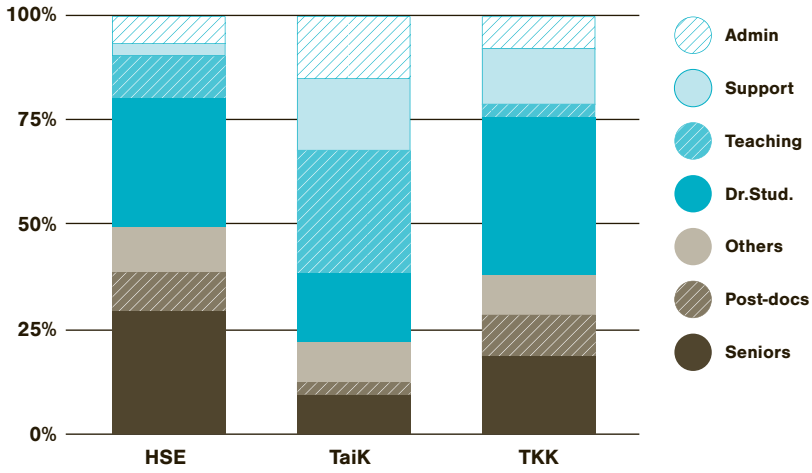


**Figure 2.4** The Structure of staff at the Units of Assessment on the Aalto RAE census date of 1 October 2008.

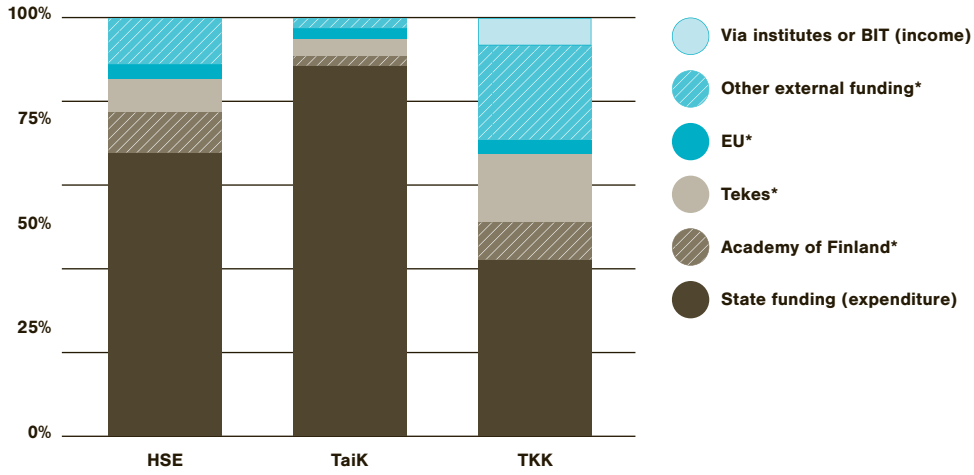


**Figure 2.5** The distribution of funding of the Units of Assessment taken together according to the source during 2003-2008. (*HSE: expenditure, TaiK and TKK: income)

# 3. Aalto University *Bibliometric Analysis* 2003–2007

## Execution of the Analysis

To complement the peer-review assessment by the Expert Panels, the data collected from the ISI Web of Science for the Aalto University Research Assessment Exercise 2009 was used also for a bibliometric analysis focusing on quantitative impact and performance indicators. The Bibliometric Analysis was performed by an external expert, docent Ulf Sandström from Linköping University, Sweden. The Aalto University Bibliometric Analysis was executed such that the results are to some extent comparable to the results of the KTH Royal Institute of Technology bibliometric analysis 2000–2006, carried out by Ulf and Erik Sandström.[9] The full Aalto University Bibliometric Analysis 2003–2007 report is available via Aalto University's public website.[10]

As in the case of the Aalto RAE, also in the Bibliometric Analysis the goal was to assess the current scientific potential of the personnel presently employed by HSE, TaiK and TKK. Thus the analysis included the publications of the individuals listed in the mapping of staff as members of the research active staff on the Aalto RAE census date of 1 October 2008 regardless of where the individuals in question had been working at the time of the publication.

## Coverage of the ISI Web of Science Database

The basic data used in the analysis consisted of the articles and conference proceedings published during the period from 2003 until 2007 (and the citations these publications had received 2003–2008) as indexed in the ISI

9 Available at http://www.kth.se/forskning/rae/1.27968?l=en_UK

10 www.aalto.fi/aaltorae

Web of Science database. Although ISI is currently the database that best covers the most prestigious journals and serials in all fields of scientific research, in case of some Units of Assessment the Scopus database would arguably have given a more comprehensive picture of the unit's research activities, because Scopus tends to include conference proceedings more extensively than the journal-oriented ISI database. However, conference papers do not get cited as often as articles. In the Aalto RAE, over 80% of all citations retrieved in Scopus were made to article publications. Recent international studies seem to confirm this observation also in other fields of research: In medicine, for example, Scopus retrieves more citations from non-English-language sources and reviews, whereas ISI retrieves more citations from articles, editorials and letters.[11]

Moreover, ISI is the internationally most widely used database in bibliometric studies. It should also be remembered that the most central bibliometric indicator in the Aalto University Bibliometric Analysis is the field-normalised citation score NCSf: the unit's score is normalised against the world average within the unit's field of research. Thus, the indicator arguably takes into account the possible issues regarding ISI's coverage of the field.

A further reason for utilising the ISI Web of Science database in the Bibliometric Analysis is that although Scopus indexes a larger amount of journals and proceedings than ISI, the citation counts for recent publications appear to be far more thoroughly updated in the ISI Web of Science. In Scopus the time lag for recent citations to show in the database appears to be considerably longer than in ISI, although the differences even out after some years. Table 3.1 presents the accumulation of articles and citations in ISI and Scopus by using TKK's publications in Physical Review Letters as an example. For the Aalto University Bibliometric Analysis this is crucial, since as Figures 2.1–2.3 demonstrate, the number of journal publications has increased significantly towards the end of the assessment period.

**Table 3.1** TKK's articles (and citations to these) in Physical Review Letters according to ISI and Scopus (databases accessed in September 2009).

| Year of Publication | Articles / Citations in ISI | Articles / Citations in Scopus |
|---|---|---|
| 2008 | 34 / 78 | 24 / 13 |
| 2007 | 41 / 188 | 41 / 171 |
| 2006 | 34 / 255 | 35 / 255 |

11 Abhaya V. Kulkarni, Brittany Aziz, Iffat Shams & Jason W. Busse, "Comparisons of Citations in Web of Science, Scopus, and Google Scholar for Articles Published in General Medical Journals", *JAMA*. 2009, 302(10), pp. 1092–1096.

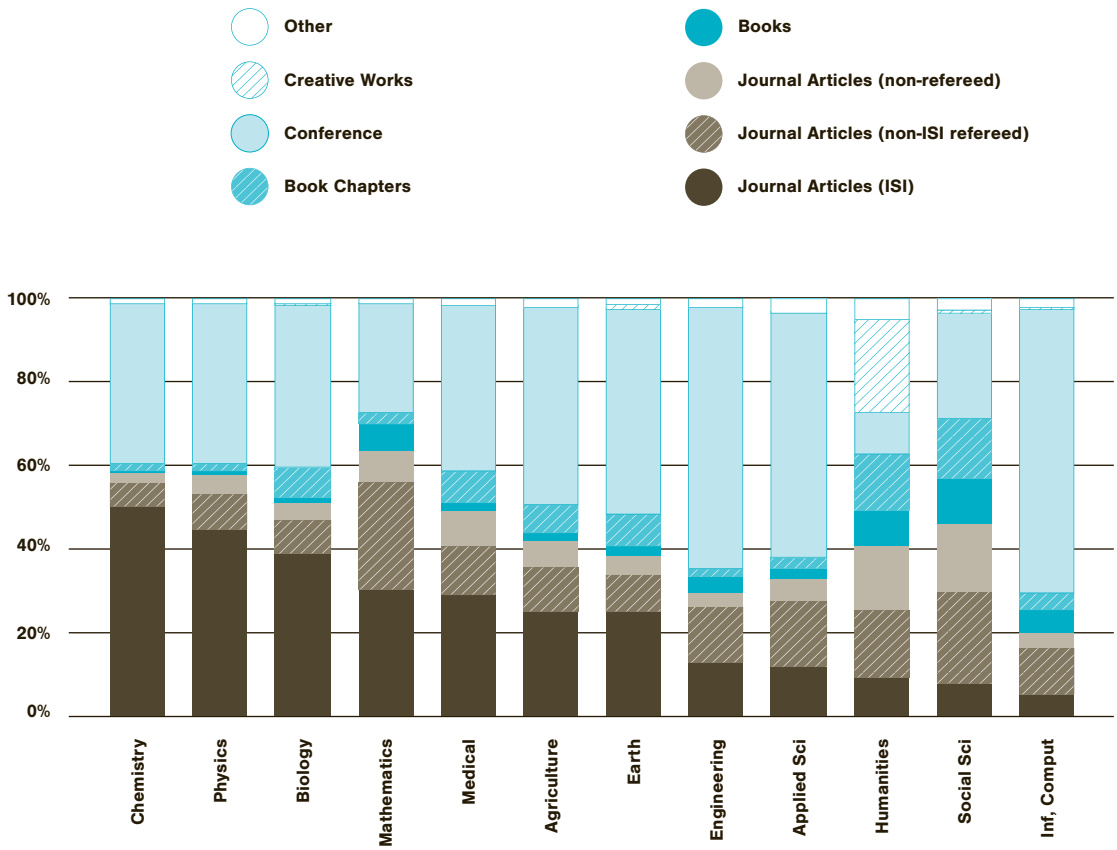


**Figure 3.1** The proportion of ISI-indexed publications in different fields of research in Australia in the mid-1990s. (Source: Linda Butler: "How Do We Value and Measure Academic Research Publications", presentation at National Scholarly Communications Forum: Death of the Book?, Sydney, 8 March 2003.)

However, ISI covers only journal publications. In some fields of research journal publications are clearly the most important channel for disseminating research results, while in some other areas books, book chapters, conference papers or creative works are at least equally important. Figure 3.1 represents the overall proportion of ISI-indexed outputs in different research areas in relation to other publication types in Australian Universities in the mid-1990s. The data in the figure is somewhat dated, because after the mid-1990s Australian universities have been required to report only four types of publications – books, book chapters, journal articles, and refereed conference proceedings. The figure is nonetheless particularly useful for Aalto University because it includes creative works that are not often reported in this context. While it is appreciated that the ISI coverage has increased in several fields from the time of the collection of this data, and the growing importance of research assessments and citations analyses have guided researchers increasingly to emphasise (ISI) journal publications, it remains the case that ISI coverage is much more comprehensive in the natural sciences than in engineering, not to mention the social sciences, humanities and art disciplines.

However, when assessing the relevance of ISI data the simple proportions of different publication types are not the only indicators that might interest us. Table 3.2 represents more recent data (and from all over the world) concerning the coverage of ISI Web of Science database in certain subfields (journal categories) relevant for Aalto University when measured in terms of the citation impact. In some fields it appears to be the case that although ISI publications represent a minority of the research outputs, they nonetheless are the publications that receive the major part of all the citations received by the different research outputs in the field. In such a case it could be argued that ISI publications are the most important tool for increasing impact on and visibility within the international scientific community.

In Table 3.2, Importance of Journals (%) represents the number of citations to documents published in journals relative to total citations, ISI Coverage of Journal Publications (%) gives the citations to articles published in ISI source journals relative to total citations to journals and Overall ISI Coverage (%) citations to articles published in ISI source journals relative to total citations (created by multiplying the first indicator by the second).

**Table 3.2** Overall ISI citation coverage for some journal categories (subfields). (Source: Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, pp. 129–130.)

| Journal Category | Importance of Journals (%) | ISI Coverage of Journal Publications (%) | Overall ISI Coverage (%) |
|---|---|---|---|
| Acoustics | 77 | 84 | 65 |
| Chemical Engineering | 77 | 87 | 66 |
| Materials Science | 83 | 89 | 74 |
| Neurosciences | 95 | 96 | 91 |
| Computer Science, Theory | 45 | 70 | 31 |
| Engineering, Civil | 51 | 71 | 36 |
| Engineering, Electrical and Electronics | 65 | 83 | 54 |
| Engineering, Mechanical | 67 | 76 | 51 |
| Chemistry | 91 | 93 | 84 |
| Business | 64 | 78 | 50 |
| Economics | 56 | 83 | 47 |
| Management | 59 | 76 | 45 |
| Biotechnology | 90 | 93 | 84 |
| Mathematics, Applied | 70 | 77 | 54 |
| Astronomy & Astrophysics | 88 | 93 | 82 |
| Physics, Mathematical | 82 | 92 | 76 |
| Physics, Applied | 87 | 93 | 81 |
| Humanities, Multidisciplinary | 20 | 55 | 11 |

# 4. Summary of Results *at the Level of* Aalto University

## Aalto University Research Assessment Exercise 2009: Main Findings

The Assessment Panels evaluated the scientific quality, scientific impact, societal impact, environment and future potential of research to be, on average, between the good and very good international levels in Aalto University. The quality of research was at the highest, outstanding international level at six Units of Assessment. Four of these managed to reach the same outstanding quality level also regarding the impact of their research on the international scientific community. This is a good result, but as Figure 4.1 shows, the real strength of Aalto University's research is the societal impact of research activities.

The Aalto University Research Assessment Exercise 2009 found the societal impact of research to be excellent in most of the Units of Assessment: almost 70% of the Units of Assessment reached either Outstanding or Very Good International Level. In particular the interaction with industry was considered to be exemplary. This cooperative interaction – and the societal impact of HSE, TaiK and TKK as the leading institutions in their respective fields in Finland in general – can be seen as a major asset and a competitive advantage for Aalto University even in the international scale.

While the Assessment Panels highly appreciated the lively interaction between the Units of Assessment and industry, the strong emphasis on industry-oriented applied research projects was also considered to form a major threat for Aalto University's ambition to be among the leading research universities in the world. In particular, currently many Aalto University units have defined neither a shared, unit-level vision for research activities nor strategic, long-term plans for realising the vision. Accordingly, in some units the direction of research activities or even the research focus is determined by the available external funding opportunities and the needs of local industries rather than by the unit's research strategy and substantial

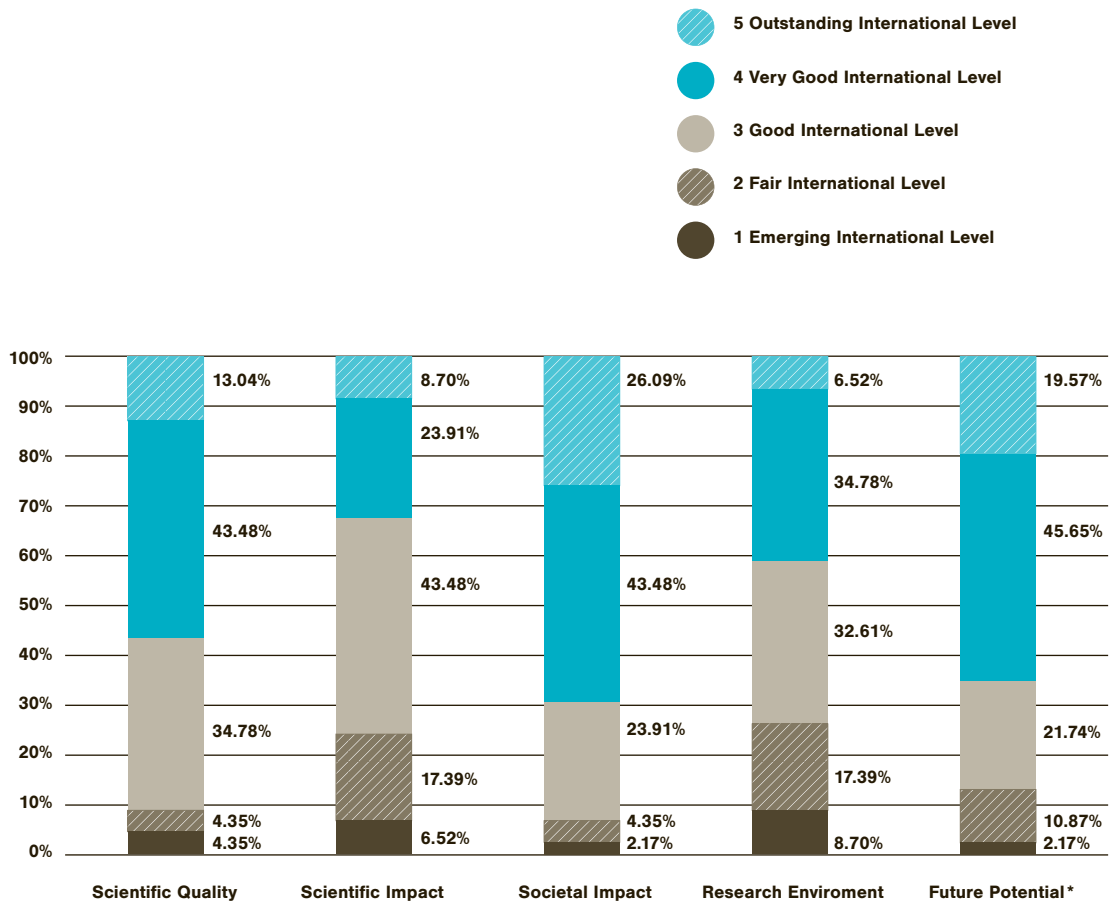


**Figure 4.1** Distribution of Numerical Ratings in Aalto RAE 2009.
(*The rating scale for Future Potential is introduced in Table 2.1.)

issues arising from the unit's participation in the international scientific debate. To reach the world class as a research university, Aalto University ought to consider shifting the research focus from opportunity-driven research to a more strategy-driven model.

A further challenge for Aalto University is the internationalisation of its research environment. The current lack of mobility (in particular, difficulties in attracting international experts to Finland) is a feature that sets Aalto University apart from its international competitors and most probably affects negatively the scientific impact and visibility of Aalto University's research and the capacity for groundbreaking innovations.

Finally, the non-existence of internationally commensurate and competitive career paths for promising young researchers is a major factor demoralising their research efforts. Setting up a tenure-track system for academic faculty is extremely important for Aalto University if and when it aims at offering an internationally comparable research environment for talented researchers.

## Aalto University Bibliometric Analysis 2003–2007: Main Findings

### Data Source, Assessment Period and Reference Group

In the Aalto University Bibliometric Analysis, conducted separately from the peer-review-based Research Assessment Exercise, the research output and citation impact of the Units of Assessment were studied with bibliometric methods using the publication records collected to the ISI Web of Science database from the years 2003–2007, and the citations received by these publications during 2003–2008. Thus, the evaluation period for publications was a year shorter than in the case of the Research Assessment Exercise, reflecting the time lag required for citations to accumulate. The citation impact of the publications of the research active staff was compared with the international average within the same research field.

### Main Bibliometric Indicators

To get as full a picture as possible, several indicators were used in the Bibliometric Analysis.

In accordance with the international practice, the field-normalised citation score NCSf can be considered to be the most important indicator. The number of citations per paper is compared with the global sub-field reference value. Thus, the NCSf score corresponds to the number of citations to publications from the researchers of the unit in question during the assessment period, compared to the world average of citations to publications of the same document types, ages and subject areas. The indicator is normalised such that the world average is 1.0. In a similar bibliometric analysis, KTH Royal Institute of Technology adopted the following classifications for NCSf score results that are used also in the present Aalto University Bibliometric Analysis:

NCSf ≤ 0.60 significantly below international average
0.60 <NCSf ≤ 1.20 at international average
1.20 <NCSf ≤ 1.80 significantly above international average
1.80 <NCSf ≤ 2.40 from an international perspective very strong
NCSf > 2.40 global excellence

These classifications are marked in Figures 4.2, 4.4 and 4.5.

Other key indicators include:

- The normalised journal citation score NJCS, which gives the average citation impact of the journals in which a unit's outputs have been published in relation to other journals in the same sub-field(s).
- The journal normalised citation score NCSj, which gives the citations per publication in relation to the average number of citations per publication in the journals in which a unit appears (taking into account the document type and year of publication).
- The top 5%, which indicated the share of publications attributed to a unit that belong to the top 5% of most cited publications in the world from the same year, in the same subject and of the same document type.
- The vitality score, which indicates the recency of cited literature (normalised in relation to the sub-field(s)).

All the indicators used in the Aalto University Bibliometric Analysis are introduced briefly in Table 4.1, and in more detail in the full Aalto University Bibliometric Report, available via the Aalto University website.[12]

**Main Results**

As can be seen in Table 4.2, the citation impact of the Aalto papers is significantly above international reference levels: they receive 25% more citations in their journals. This translates to a field-normalised citation score of a significant 23% above world average, which can be explained by the fact that Aalto researchers publish in journals with high impact-levels – 12% above the global reference value. Table 4.2 presents the results both for Aalto University taken together and for the TKK part of Aalto University.

Aalto papers occur about 30% more often than expected among the top 5% most frequently cited papers in their subfields. 11 out of the 46 units have at least the expected number of papers in the 5% category. Research at Aalto University seems to have a high vitality, i.e. research published in international journals has high reference recency. This indicates that the performed research is close to the research front in several areas of science and technology.

12 www.aalto.fi/aaltorae

Aalto University researchers contribute substantially to international scientific networks: 39.2% of papers are the result of international collaborations. A sizeable part of impact comes from publications that are internationally co-authored, and, clearly, collaborative papers receive higher citation impact.

Table 4.3 represents the results at the level of the Units of Assessment. As can be seen from the table, the field-normalised impact of nine Units of Assessment is well above average, and for six of these there is a significantly high score. Of the units that have produced sufficiently many ISI publications for the field-normalised citation score to be applicable, only five are cited significantly below average (<0.60). Many of these units have rather few publications, and their total activities are presumably not covered by the ISI Web of Science database. In general, the number of papers (P) should be approximately 30 at the very minimum (and ideally at least 50) for the bibliometric analysis to yield reliable results.

**Table 4.1** Bibliometric Indicators used in the Aalto University Bibliometric Analysis 2003–2007 (UoA refers to the Unit of Assessment)

| | | |
|---|---|---|
| **P** | NUMBER OF PAPERS | Number of papers (articles, proceeding papers and reviews) published by (UoA) "NN" during 2003–2007. |
| **Frac P** | NUMBER OF FRACTIONALISED PAPERS | Sum of author fractionalised papers (articles, proceeding papers and reviews) published by UoA "NN" during 2003–2007. |
| **CPP** | CITATIONS PER PAPER | Number of citations per paper (31 December 2008). |
| **C2YR** | CPP 2 YEAR | Citations per paper with a 2-year citation window |
| **NCSj** | FIELD-NORMALISED CITATION SCORE (Crown Indicator) | CPP normalised in relation to the UoA "NN" journal set (average=1.00). |
| **NJCS** | NORMALISED JOURNAL CITATION SCORE | The impact of the journal set normalised in relation to its sub-fields (average=1.00). |
| **NCSf** | FIELD-NORMALISED CITATION SCORE (Crown Indicator) | CPP normalised in relation to the UoA "NN" sub-field set (average=1.00). |
| **SCSf** | STANDARD FIELD CITATION SCORE | Z-score standardised citation score in relation to the UoA "NN" sub-field set (N.B! average=0.00). |
| **TOP5%** | SHARE OF PAPERS WITHIN TOP 5% | Percentage of papers above the 95th citation percentile. |
| **VITALITY** | VITALITY | Recency of references. |
| **SCIT** | PERCENTAGE SELF-CITATIONS | Percentage of self-citations. |
| **PNC** | PERCENTAGE NOT CITED PAPERS | Percentage of not cited papers during the period. |
| **INCOLLm** | INTERNATIONAL COLLABORATION | Mean number of countries per paper from the UoA "NN". |
| **AUm** | AUTHOR MEAN | Mean number of Authors per paper |

**Table 4.2** Results of the Aalto University Bibliometric Analysis 2003–2007 at the levels of Aalto University and TKK

| Symbol | Indicator | Aalto University Score 2003–2007 (all 46 units) | TKK Score 2003–2007 (TKK units only) |
|---|---|---|---|
| **PERS** | NUMBER OF PERSONNEL | **2 192** | **1 817** |
| **P** | NUMBER OF PAPERS | **4446** | **4 262** |
| **Frac P** | NUMBER OF FRACTIONALISED PAPERS | **1990** | **1880.3** |
| **CPP** | CITATIONS PER PAPER | **4.68** | **4.80** |
| **C2YR** | CPP WITH A 2-YEAR WINDOW | **2.77** | **2.86** |
| **NCSj** | JOURNAL NORMALISED CITATION SCORE | **1.26** | **1.28** |
| **NJCS** | NORMALISED JOURNAL CITATION SCORE | **1.12** | **1.11** |
| **NCSf** | FIELD-NORMALISED CITATION SCORE (Crown Indicator) | **1.23** | **1.23** |
| **SCSf** | STANDARD FIELD CITATION SCORE | **0.21** | **0.22** |
| **TOP5%** | SHARE OF PAPERS WITHIN TOP 5% | **6.5%** | **6.74%** |
| **VITALITY** | VITALITY | **1.11** | **1.11** |
| **SCIT** | PERCENTAGE SELF-CITATION | **13.4%** | **12.6%** |
| **PNC** | PERCENTAGE NOT CITED PAPERS | **31%** | **22.7%** |
| **INCOLLm** | INTERNATIONAL COLLABORATION | **1.7** | **1.7** |
| **AUm** | AUTHOR MEAN | **5.6** | **5.7** |

**Table 4.3** Aalto University Bibliometric Results 2003–2007 per Unit of Assessment

| Panel and Unit of Assessment | P | Frac P | CPP | C2YR | NCSj | NJCS |
|---|---|---|---|---|---|---|
| **Panel 1: Chemical Technology and Materials** | | | | | | |
| Biotechnology and Chemical Technology, TKK | 252 | 108.3 | 3.97 | 2.14 | 0.82 | 1.06 |
| Chemistry, TKK | 300 | 89.1 | 10.77 | 6.13 | 1.43 | 1.31 |
| Materials Science and Engineering, TKK | 177 | 78.3 | 3.12 | 1.66 | 1.10 | 0.76 |
| Forest Products Technology, TKK | 226 | 81.8 | 3.33 | 1.89 | 2.01 | 1.05 |
| | | | | | | |
| **Panel 2: Electronics and Electrical Engineering** | | | | | | |
| Electronics, TKK | 67 | 31.9 | 4.47 | 2.51 | 2.60 | 0.63 |
| Radio Science and Engineering, TKK | 312 | 169.0 | 4.63 | 2.66 | 1.96 | 1.11 |
| Signal Processing and Acoustics, TKK | 173 | 73.7 | 3.10 | 1.71 | 1.32 | 0.91 |
| Electrical Engineering, TKK | 89 | 46.5 | 1.87 | 1.02 | 1.25 | 0.72 |
| Metsähovi Radio Observatory, TKK | 68 | 9.3 | 6.77 | 5.42 | 0.81 | 1.03 |
| | | | | | | |
| **Panel 3: Mathematics and Physics** | | | | | | |
| Biomedical Engineering and Computational Science, TKK | 239 | 79.1 | 6.41 | 3.89 | 1.21 | 1.14 |
| Mathematics and Systems Analysis, TKK | 144 | 78.5 | 2.59 | 1.41 | 1.44 | 1.17 |
| Applied Physics, TKK | 996 | 341.9 | 8.42 | 5.05 | 1.37 | 1.38 |
| Micro and Nanosciences, TKK | 253 | 93.9 | 3.57 | 2.35 | 0.91 | 1.09 |
| Low Temperature Laboratory, TKK | 367 | 157.8 | 6.65 | 4.46 | 1.05 | 1.41 |

| NCSf | SCSf | TOP5% | VITALITY | INCOLLm | AUm | SCIT | PNC |
|---|---|---|---|---|---|---|---|
| 0.82 | 0.01 | 2.0% | 1.03 | 1.1 | 4.4 | 13.0% | 24.0% |
| 1.60 | 0.31 | 9.7% | 1.06 | 1.6 | 5.1 | 10.6% | 15.1% |
| 0.79 | -0.06 | 1.4% | 1.05 | 1.4 | 4.2 | 19.6% | 35.3% |
| 1.47 | 0.28 | 4.4% | 1.14 | 1.5 | 4.3 | 16.3% | 30.4% |
| 0.91 | -0.02 | 0.0% | 1.19 | 1.3 | 3.7 | 5.6% | 50.3% |
| 1.62 | 0.46 | 11.4% | 1.09 | 1.5 | 5.1 | 14.7% | 27.1% |
| 1.02 | 0.15 | 5.5% | 1.05 | 1.5 | 3.9 | 16.8% | 35.6% |
| 0.81 | 0.02 | 0.5% | 0.91 | 1.5 | 3.1 | 21.2% | 43.0% |
| 0.90 | 0.17 | 1.5% | 1.06 | 6.4 | 43.6 | 10.6% | 14.6% |
| 1.25 | 0.25 | 6.5% | 1.14 | 1.5 | 4.8 | 9.7% | 21.9% |
| 1.57 | 0.32 | 11.4% | 1.10 | 1.5 | 2.9 | 20.8% | 44.6% |
| 1.76 | 0.52 | 13.2% | 1.22 | 2.1 | 8.3 | 11.8% | 16.6% |
| 0.96 | 0.02 | 5.2% | 1.12 | 1.4 | 6.0 | 17.1% | 33.6% |
| 1.18 | 0.32 | 4.2% | 1.10 | 1.8 | 4.6 | 11.0% | 14.1% |

**Table 4.3 (contd.)** Aalto University Bibliometric Results 2003–2007 per Unit of Assessment

| Panel and Unit of Assessment | P | Frac P | CPP | C2YR | NCSj | NJCS |
|---|---|---|---|---|---|---|
| **Panel 4: Computer Science and Information Technology** | | | | | | |
| Media Technology, TKK | 36 | 15.6 | 1.01 | 0.55 | 0.39 | 1.05 |
| Computer Science and Engineering, TKK | 51 | 28.6 | 0.63 | 0.46 | 0.74 | 0.68 |
| Information and Computer Science, TKK | 234 | 123.2 | 2.18 | 1.49 | 1.51 | 1.03 |
| Communications and Networking, TKK | 111 | 58.4 | 1.03 | 0.67 | 0.68 | 0.99 |
| Helsinki Institute for Information Technology (HIIT), TKK | 35 | 14.5 | 2.27 | 1.44 | 1.24 | 0.84 |
| | | | | | | |
| **Panel 5: Mechanical Engineering and Automation** | | | | | | |
| Energy Technology, TKK | 71 | 43.7 | 1.68 | 0.84 | 0.60 | 0.88 |
| Engineering Design and Production, TKK | 66 | 30.1 | 4.42 | 1.56 | 1.32 | 0.73 |
| Applied Mechanics, TKK | 34 | 24.6 | 0.99 | 0.34 | 0.66 | 0.86 |
| Automation and Systems Technology, TKK | 26 | 13.2 | 0.76 | 0.58 | 0.41 | 1.11 |
| | | | | | | |
| **Panel 6: Civil Engineering and Urban and Regional Studies** | | | | | | |
| Surveying, TKK | 7 | 2.6 | 2.04 | 0.74 | 0.30 | 0.53 |
| Structural Engineering and Building Technology, TKK | 41 | 19.0 | 1.16 | 0.72 | 0.54 | 0.96 |
| Civil and Environmental Engineering, TKK | 51 | 24.3 | 2.86 | 1.89 | 1.09 | 0.82 |
| The Lahti Center, TKK | 2 | 1.5 | 0 | 0 | 0 | 0.55 |
| Centre for Urban and Regional Studies (YTK), TKK | 7 | 5.4 | 1.60 | 0.86 | 0.27 | 0.76 |

| NCSf | SCSf | TOP5% | VITALITY | COLLm | AUm | SCIT | PNC |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 0.52 | -0.20 | 0.0% | 1.21 | 1.1 | 3.3 | 6.9% | 69.1% |
| 0.45 | -0.17 | 0.0% | 1.09 | 1.2 | 2.9 | 10.5% | 62.7% |
| 1.28 | 0.30 | 6.3% | 1.13 | 1.4 | 3.6 | 7.9% | 43.1% |
| 0.65 | -0.15 | 3.6% | 1.09 | 1.4 | 2.9 | 11.9% | 60.0% |
| 0.94 | 0.20 | 6.9% | 1.28 | 1.3 | 3.4 | 10.6% | 41.7% |
| | | | | | | | |
| | | | | | | | |
| 0.54 | -0.21 | 2.3% | 1.01 | 1.1 | 2.9 | 13.7% | 41.5% |
| 0.94 | 0.04 | 3.3% | 1.26 | 1.2 | 4.3 | 21.1% | 35.8% |
| 0.57 | -0.23 | 0.0% | 0.95 | 1.1 | 2.4 | 17.2% | 55.9% |
| 0.38 | -0.37 | 0.0% | 0.98 | 1.2 | 3.2 | 10.4% | 57.1% |
| | | | | | | | |
| | | | | | | | |
| 0.29 | -0.78 | 0.0% | 0.96 | 2.0 | 4.0 | 1.6% | 72.5% |
| 0.48 | -0.25 | 0.0% | 1.05 | 1.3 | 3.2 | 26.4% | 46.9% |
| 1.05 | 0.02 | 6.2% | 1.39 | 1.3 | 3.5 | 11.7% | 34.4% |
| 0 | -0.96 | 0.0% | 0.94 | 1.0 | 1.5 | 0.0% | 100.0% |
| 0.36 | -0.70 | 0.0% | 1.19 | 1.0 | 1.9 | 18.5% | 69.2% |

**Table 4.3 (contd.)** Aalto University Bibliometric Results 2003–2007 per Unit of Assessment

| Panel and Unit of Assessment | P | Frac P | CPP | C2YR | NCSj | NJCS |
|---|---|---|---|---|---|---|
| **Panel 7: Business Technology, Economics and Finance** | | | | | | |
| Accounting and Finance, HSE | 12 | 8.2 | 2.35 | 1.16 | 0.50 | 1.53 |
| Business Technology, HSE | 54 | 24.3 | 3.09 | 1.29 | 0.96 | 1.19 |
| Economics, HSE | 36 | 19.3 | 1.97 | 0.72 | 0.74 | 1.24 |
| | | | | | | |
| **Panel 8: Marketing, Management and Applied Business Research** | | | | | | |
| Center for Markets in Transition (CEMAT), HSE | 1 | 1.0 | 2.00 | 1.00 | 1.09 | 0.84 |
| Center for Knowledge and Innovation Research (CKIR), HSE | 31 | 18.0 | 2.52 | 1.45 | 1.02 | 1.51 |
| Languages and Communication, HSE | 2 | 1.3 | 1.75 | 1.00 | 1.40 | 0.65 |
| Marketing and Management, HSE | 53 | 30.8 | 3.42 | 1.60 | 1.04 | 0.89 |
| Industrial Engineering and Management, TKK | 44 | 22.2 | 4.14 | 2.07 | 1.03 | 1.34 |
| Business, Innovation and Technology Research Centre (BIT), TKK | 26 | 14.6 | 1.49 | 0.93 | 0.79 | 0.86 |
| | | | | | | |
| **Panel 9: Architecture, Design, Media and Art Research** | | | | | | |
| Designium Innovation Centre, TaiK | 1 | 0.3 | 0 | 0 | 0 | 0.43 |
| Motion Picture, Television and Production Design, TaiK | 1 | 1.0 | 0 | 0 | 0 | 1.28 |
| Future Home Institute, TaiK | 0 | 0.0 | 0 | 0 | 0 | 0 |
| Media Lab, TaiK | 8 | 5.4 | 0.07 | 0.04 | 0.02 | 1.10 |
| Design, TaiK | 1 | 1.0 | 0 | 0 | 0 | 7.76 |
| Art and Media Pori, TaiK | 0 | 0 | 0 | 0 | 0 | 0 |
| Art Education, TaiK | 1 | 0.5 | 2.00 | 1.00 | 1.14 | 0.54 |
| Visual Culture, TaiK | 0 | 0 | 0 | 0 | 0 | 0 |
| Architecture, TKK | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| **Total** | 4451 | 1992 | 4.68 | 2.77 | 1.25 | 1.12 |

| NCSf | SCSf | TOP5% | VITALITY | COLLm | AUm | SCIT | PNC |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 0.63 | 0.04 | 0.0% | 1.17 | 1.3 | 1.9 | 2.4% | 36.7% |
| 1.15 | 0.21 | 4.5% | 0.97 | 1.6 | 2.9 | 12.6% | 35.5% |
| 0.74 | 0.03 | 0.0% | 1.08 | 1.5 | 2.1 | 13.0% | 37.1% |
| | | | | | | | |
| | | | | | | | |
| 0.91 | 0.36 | 0.0% | 0.58 | 1.0 | 1.0 | 0.0% | 0.0% |
| 2.95 | 0.28 | 0.0% | 1.01 | 1.2 | 3.6 | 40.4% | 33.5% |
| 0.70 | 0.10 | 0.0% | 0.97 | 1.5 | 3.0 | 0.0% | 0.0% |
| 0.98 | 0.08 | 3.8% | 0.99 | 1.4 | 2.6 | 7.6% | 34.4% |
| 1.53 | 0.42 | 9.7% | 0.99 | 1.5 | 2.7 | 6.3% | 27.4% |
| 0.57 | -0.10 | 1.4% | 1.02 | 1.1 | 2.8 | 6.0% | 49.5% |
| | | | | | | | |
| | | | | | | | |
| 0 | -0.96 | 0.0% | 1.16 | 4.0 | 4.0 | 0.0% | 100.0% |
| 0 | -0.22 | 0.0% | 0.81 | 1.0 | 1.0 | 0.0% | 100.0% |
| 0 | 0 | 0.0% | 0 | 0.0 | 0.0 | 0.0% | 0.0% |
| 0.03 | -0.32 | 0.0% | 1.84 | 1.4 | 2.1 | 0.0% | 96.3% |
| 0 | -0.14 | 0.0% | 2.73 | 1.0 | 1.0 | 0.0% | 100.0% |
| 0 | 0 | 0.0% | 0 | 0.0 | 0.0 | 0.0% | 0.0% |
| 0.61 | 0.13 | 0.0% | 0.86 | 1.0 | 2.0 | 0.0% | 0.0% |
| 0 | 0 | 0.0% | 0 | 0.0 | 0.0 | 0.0% | 0.0% |
| 0 | 0 | 0.0% | 0 | 0.0 | 0.0 | 0.0% | 0.0% |
| | | | | | | | |
| 1.23 | 0.21 | 6.5% | 1.11 | 1.7 | 5.6 | 13.4% | 31.0% |

## Comparison of the Main Findings of the Research Assessment Exercise and the Bibliometric Analysis

As mentioned before, the number of papers (P) should be approximately 30 at the very minimum (and ideally at least 50) for the bibliometric analysis to yield reliable and incontestable results. Accordingly, in what follows the Units of Assessment with a clearly too small number of ISI publications have been excluded from the figures that include the main bibliometric indicator NCSf (field-normalised citation score).

Figure 4.2 shows the field-normalised citation scores, based on the Aalto University Bibliometric Analysis, and the average of the Aalto University Research Assessment Exercise ratings of the scientific quality and scientific impact of the 31 Units of Assessment that had produced sufficiently many ISI articles for the bibliometric analysis to be applicable. In general, the bibliometric results appear to correspond well with the views of the Assessment Panels. However, the agreement is simply a broad tendency; units at the same RAE quality level vary greatly in terms of their citation index and vice versa.

### Anomalies and General Observations

The most salient anomaly in Figure 4.2 – and a striking example of issues involved in comparing bibliometric results with panel assessments – is the unit with the very impressive NCSf score of 2.95 and the rather low RAE rating of 2.5 at the top of the figure. This unit has produced only 31 ISI articles and, what is more, a single researcher is involved in 28 of them. This researcher and his co-authors are conducting highly successful research in a field that the panel considered to be somewhat peripheral within the research activities of the unit, and accordingly in the view of the panel their remarkable achievements do not warrant a higher rating for the unit taken as a whole. Interestingly, should the other researchers of the unit succeed in producing ISI articles in the near future, then – even if the currently flourishing researchers maintain their excellent citation record – the NCSf score for the whole unit will most probably drop, for these other researchers cannot realistically be expected to reach immediately the amazing citation impact of the unit's current ISI authors. Should this rather probable scenario be realised, then the factual research quality and impact of the unit as a whole should presumably be considered to be increasing, although the unit's NCSf score would show a declining trend.

The research performance of this unit is discussed in more detail in Part III of this volume. Here the unit's results merely serve as an illustration of the fact that neither bibliometrics nor panel assessment can be considered to reveal in an uncomplicated manner the quality or impact of a unit's research activities, and even together they cannot be interpreted without detailed knowledge concerning (i) the unit in question, (ii) the substantive content of the works under evaluation, and (iii) the specific features of the assessment process. What a bibliometric analysis and a panel assessment

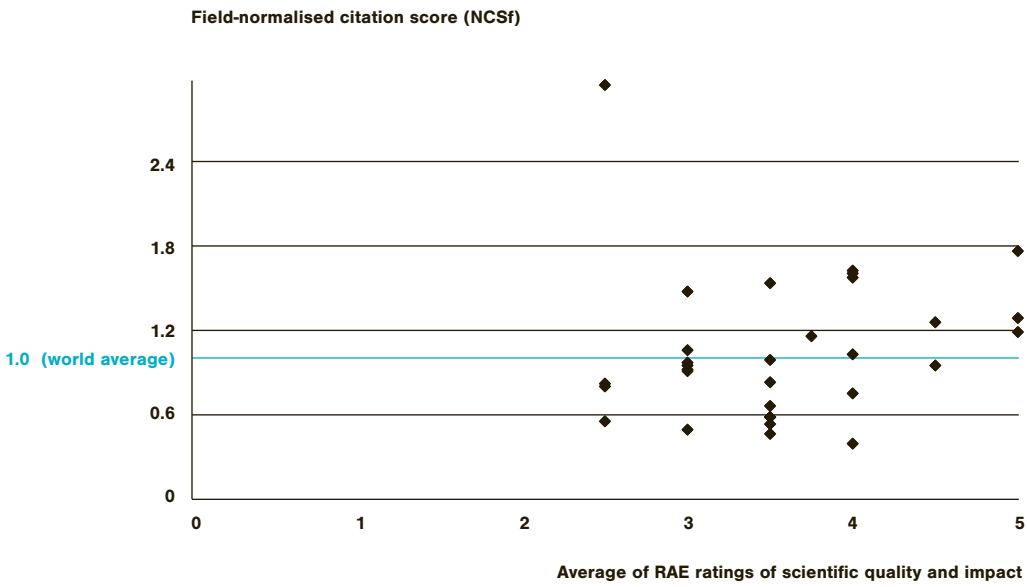


**Figure 4.2** Field-normalised citation scores of the units as a function of the average of the RAE scientific quality and scientific impact ratings.

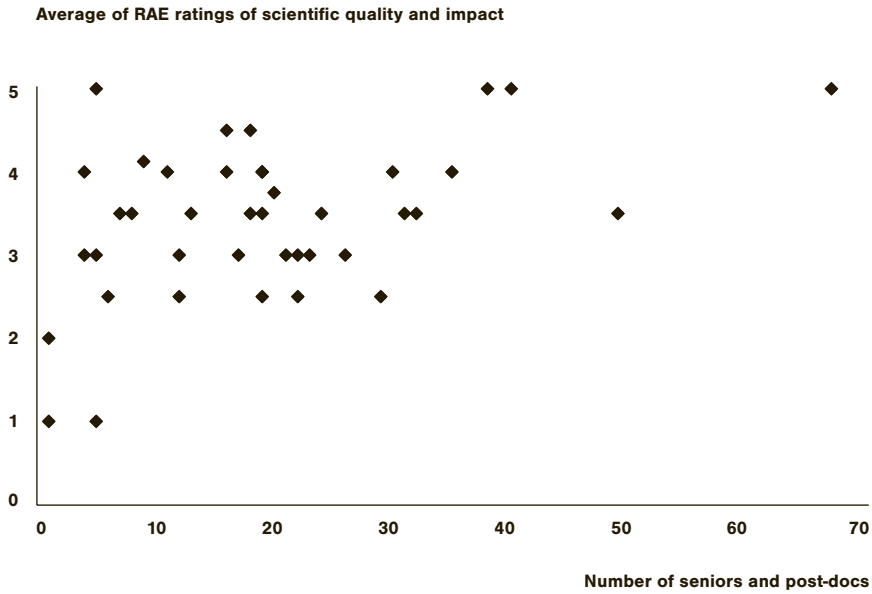


**Figure 4.3** Average of RAE ratings of scientific quality and scientific impact of the unit as a function of the number of senior and postdoctoral research active staff at the unit.

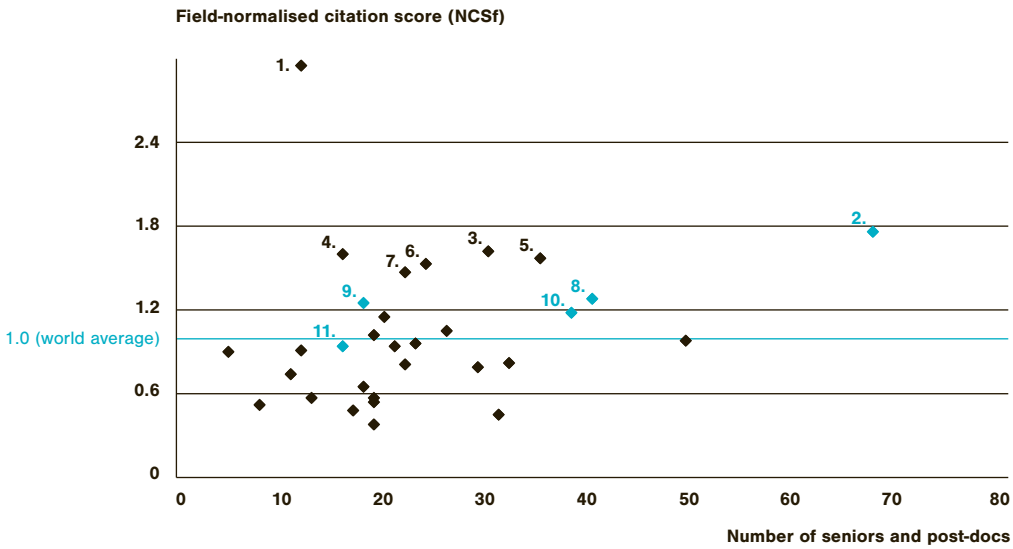


**Figure 4.4** Field-normalised citation score of the unit as a function of number of seniors and post-docs. (1. Center for Knowledge and Innovation Research (CKIR), 2. Department of Applied Physics, 3. Department of Radio Science and Engineering, 4. Department of Chemistry, 5. Department of Mathematics and System Analysis, 6. Department of Industrial Engineering and Management, 7. Department of Forest Products Technology, 8. Department of Information and Computer Science, 9. Department of Biomedical Engineering and Computational Science, 10. Low Temperature Laboratory, 11. Helsinki Institute for Information Technology (HIIT))

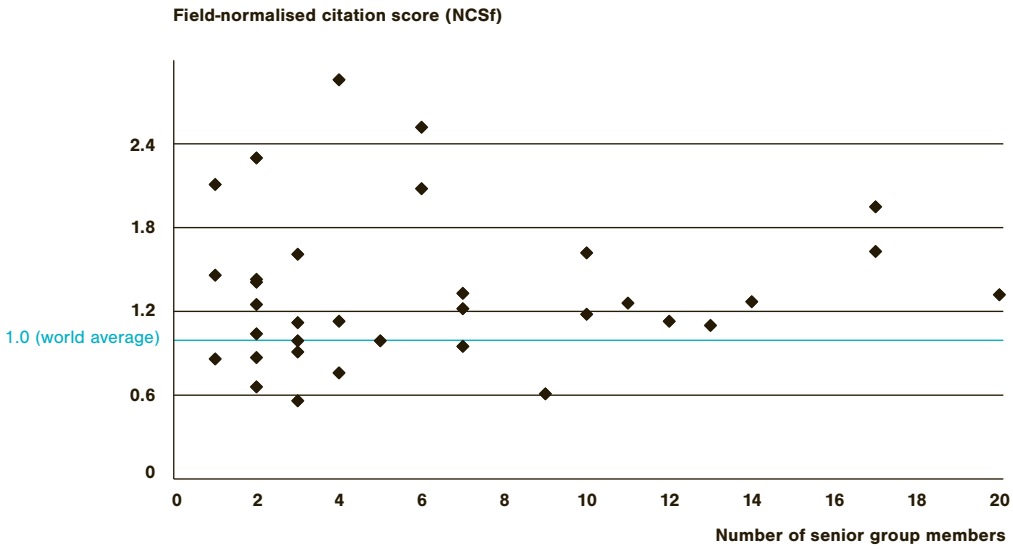


**Figure 4.5** Field-normalised citation score of the research group as a function of the number of senior group members.

can offer, especially when taken together, however, is helpful material for strategic development of the Units of Assessment. The evaluation results provide a fruitful starting point for deeper discussions concerning the research activities of the Units of Assessment.

A recurring theme in the panel assessments was the worry that the research active staff at many Units of Assessment does not reach the critical size required for research excellence. Figure 4.3 shows the average of the RAE ratings of scientific quality and scientific impact for each Unit of Assessment as the function of the number of senior and postdoctoral research staff at the unit in question.

There appears to be a rough correlation between the size of the (senior) research active staff and the quality and scientific impact of the unit's research. Moreover, the apparent counterexamples in the top left-had corner of the figure include many TaiK units where the high quality of the unit's research effort is no doubt partly dependent on the contributions of the unit's artistic and other practice-oriented professors and other personnel that are not included in the research active staff.

A further evidence for the hypothesis is given by Figure 4.4, which shows the units' field-normalised citation score NCSf (based on the Aalto University Bibliometric Analysis and therefore independent of the views of the panels) as the function of the number of senior and postdoctoral research active staff. This figure shows the same trend.

Figure 4.4 invites also further comments. Blue dots indicate units that received the highest, outstanding rating (5) for their quality of research from the Assessment Panels. These units received also relatively good NCSf scores in the Bibliometric Analysis. The NCSf score of the Helsinki Institute for Information Technology (HIIT, number 11 in Figure 4.4) is not representative for HIIT, since HIIT is a joint institute of TKK and the University of Helsinki, but the bibliometric data that the NCSf score is based on relates only to those members of HIIT that are employed by TKK and, moreover, do not have a further affiliation with other TKK units. The panel assessment, in contrast, applies to the whole of HIIT, for in practice the distinction between the TKK and other HIIT members, not to mention the distinction between those members that have a double affiliation and those who do not, is entirely artificial. The sixth unit that received the highest scientific quality rating from the Assessment Panels, TaiK's School of Design, is not included in Figure 4.4, for the unit has produced only one ISI publication during the assessment period and, thus, the NCSf score is not applicable to the unit.

There are also a few units (numbers 3–7 in Figure 4.4) that received a relatively impressive field-normalised citation score in the Bibliometric Analysis but that did not receive a correspondingly high quality rating in the panel assessment. The most notable example of these units is TKK's Department of Forest Products Technology (number 7 in Figure 4.4) which the panel assessed to remain below the Aalto University average in terms of the quality and scientific impact of its research, while its NCSf score of 1.47

is significantly above the international average and as such a noteworthy achievement.

Finally, it might look surprising that although many Aalto University units operate significantly above the international citation impact average, in light of the field-normalised citation score only one Unit of Assessment reaches either the very strong international level (1.80 < NCSf ≤ 2.40) or the undoubted global excellence (NCSf > 2.40). However, it should be kept in mind that the present analysis is conducted at the level of whole academic departments (or research institutes) that typically comprise several academic disciplines and a number of research groups working at varying quality, productivity and impact levels. Figure 4.5 represents the field-normalised citation score NCSf of those sub-departmental research groups that have produced a sufficient number of ISI articles for the NCSf score to be meaningful. As can be seen, two of such groups reach the undoubted global excellence and four function at the very strong international level.

Finally, Figure 4.5 sheds more light on the theme discussed above, i.e. whether there is a correlation between the size of a research group and its citation impact. While the trend is still there, Figure 4.5 might be seen to suggest that the large size of the group is neither sufficient nor necessary for research excellence. Sometimes the correlation may be explained by high-performing small units having been encouraged to grow into larger units, rather than large size always preceding high quality.

## Conclusion

In summary, the experiences of the Aalto University evaluation project that combines peer-review with bibliometric analysis support the view that truly useful research evaluations ought to combine advanced bibliometric indicators and informed peer-reviews.[13] Analysing the quality and impact of scientific research is a wonderfully complicated task which does not permit shortcuts; there are no general and simple indicators that can reliably measure the quality of research in many different fields. Thus, the real challenge for future research evaluations is not to find the right method but to combine different methods such that the distinctive strengths of the utilised methods compensate for the limitations inherent in any single method.

13 Cf. Henk F. Moed: "The Future of Research Evaluation Rests with an Intelligent Combination of Advanced Metrics and Transparent Peer Review", *Science and Public Policy* 34(8), 2007, pp. 575–583 and Linda Butler: "Assessing University Research: A Plea for a Balanced Approach", *Science and Public Policy* 34(8), 2007, pp. 565–574.

# 5. Summary of Results *at the Level of* Units of Assessment

## Introduction

This Part summarises the results of the Aalto University Research Assessment Exercise 2009 and the Aalto University Bibliometric Analysis 2003–2007 at the level of each Unit of Assessment. The full Panel and Bibliometric Reports are available at the Aalto University website.[14]

The section on each panel opens with a summary of the Expert Panel's overview of the units covered by the panel and a short comment concerning the applicability of the Aalto University Bibliometric Analysis 2003–2007 to the units covered by the panel.

Moreover, the sections on each panel include five figures. The first figure gives the total number of staff at each Unit of Assessment covered by the panel in question on the Aalto RAE Census Date of 1 October 2008. The figure also shows how the staff divides into Senior Research Staff, Post-doctoral Research Staff, Other Research Staff and Doctoral Students (these four categories form together the Research Active Staff of the unit in question) as well as into Teaching, Support and Administrative Staff.

The second figure shows the average annual funding of each Unit of Assessment covered by the panel in question during the assessment period. The figure shows the amount of Government budget funding, funding from the Academy of Finland, Tekes and EU, other external funding and, when applicable, funding via institutes or BIT. This last category refers to funding acquired by the researchers at the unit under consideration but managed at TKK's separate research institutes. Activities funded this way are often carried out by the researchers of the unit in question at a separate institute.

14 www.aalto.fi/aaltorae

The third figure denotes the number of refereed, international articles, review articles and conference proceedings from the assessment period 2003–2007 by the research active staff of the unit in question, and the number of citations received by these publications in 2003–2008, as indexed in the ISI Web of Science and Scopus databases. The figure shows also the total number of refereed, international articles and conference papers from the period 2003–2008 as listed in the Aalto database, which is built on the basis of HSE, TaiK and TKK's local research databases. The figure shows at a glance how well e.g. the ISI database, on which the Aalto University Bibliometric Analysis is based, covers the total international article publications of different Units of Assessment.

The fourth figure, then, shows the overall publication profiles of the units covered by the panel in question. This figure shows the relative amounts of different publication types, both international and Finnish (including in the case of TaiK's units also artistic productions including a research element), within the research outputs of the units in question.

Finally, the fifth figure represents the most central research indicators of all the Units of Assessment covered by the panel in question. The indicators in this figure comprise the panel assessments of scientific quality, scientific impact and societal impact, the bibliometric indicators of the number of ISI publications and the field-normalised citation score NCSf, and the resource indicators of the amount of total funding and the number of senior and post-doctoral research staff. All the indicators except the field-normalised citation score are panel-normalised in the figure, i.e. normalised in relation to the average score within the panel in question such that the average within the panel is 1.0. The field-normalised citation score is normalised in relation to the world average in the subfield(s) represented by the unit in question such that 1.0 is the world average in the unit's own field of research.

In addition to these figures, the section on each panel includes a short introduction to each Unit of Assessment based mainly on the Self-Assessment Reports, the summaries of the Panel Assessments of each Unit of Assessment and, when applicable, some observations concerning the insights into each Unit of Assessment as offered by the Bibliometric Analysis.

# Panel 1: Chemical Technology and Materials

## Units of Assessment

**Department of Biotechnology and Chemical Technology,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Chemistry,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Materials Science and Engineering,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Forest Products Technology,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

## Overview

Panel 1 was particularly impressed by the collaboration between the Units of Assessment and industry. Indeed, the collaboration has perhaps become overemphasised in the units' research activities, which tend to be dominated by short-term applied and industry-led small projects. Sometimes it even seems that the industrial partners focus more on basic science than the Units of Assessment. Applicability and industrial relevance appear to override the potential for characteristically scientific breakthroughs as the core virtues that guide the research efforts at many Units of Assessment.

A further issue observed by the Panel is the lack of international mobility of research staff (in particular inbound, but also outbound): the staff is predominantly not only Finnish but also with very little or no experience from any other university. A striking problem that most likely contributes also to the shortage of international experts at the Units of Assessment is the lack of career opportunities and, consequently, the lack of motivation among postdoctoral researchers. The Panel recommends seriously that Aalto University establishes an internationally comparable career system (a tenure-track system) for research active staff.

Finally, the Panel notes that a problem concerning all Finnish universities is the existence of research groups and departments of a clearly subcritical size. This problem is accentuated by the lack of long-term, strategic planning of research activities in order to systematically strengthen the characteristic features that separate the unit in question from other units in the same field of research. The reluctance to specialise and strategically position units in the scientific community creates at the national level a serious risk of parallel weak efforts at different universities.

The disciplines covered by Panel 1 are such that a bibliometric analysis based on the ISI Web of Science can be seen to suit them very well. In Chemistry, for example, 91% of all references world-wide are to documents published in journals, and ISI covers 93% of these. In Chemical Engineering the same figures are 77% and 87%, in Biotechnology 90% and 93%, and in Materials Science 83% and 89%, respectively.[15] Thus, within these disciplines, the vast majority of citations are to ISI publications. As Figures 5.1.3 and 5.1.4 show, the ISI coverage is rather respectable also at the Units of Assessment.

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

15 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, pp. 129-130.

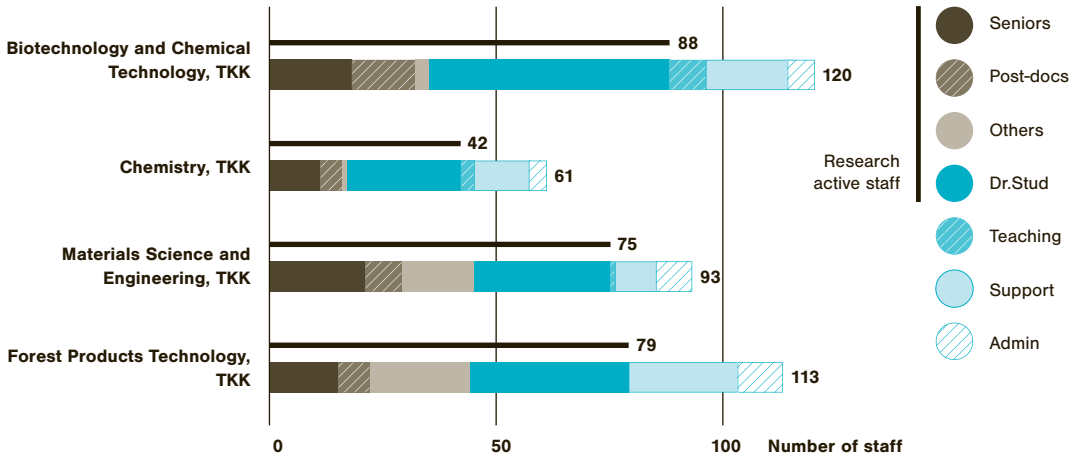


**Figure 5.1.1** Number of staff on the Aalto RAE census date of 1 October 2008.

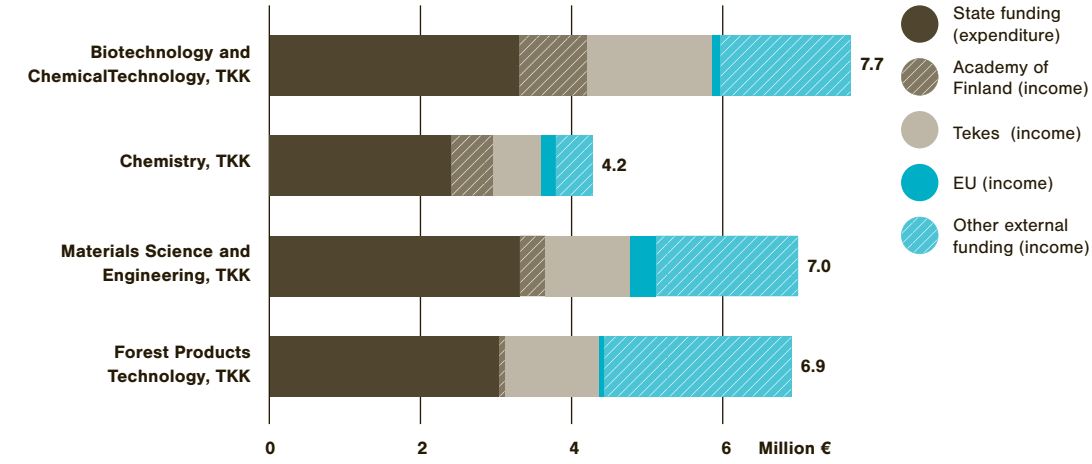


**Figure 5.1.2** Average annual funding during 2003–2008.

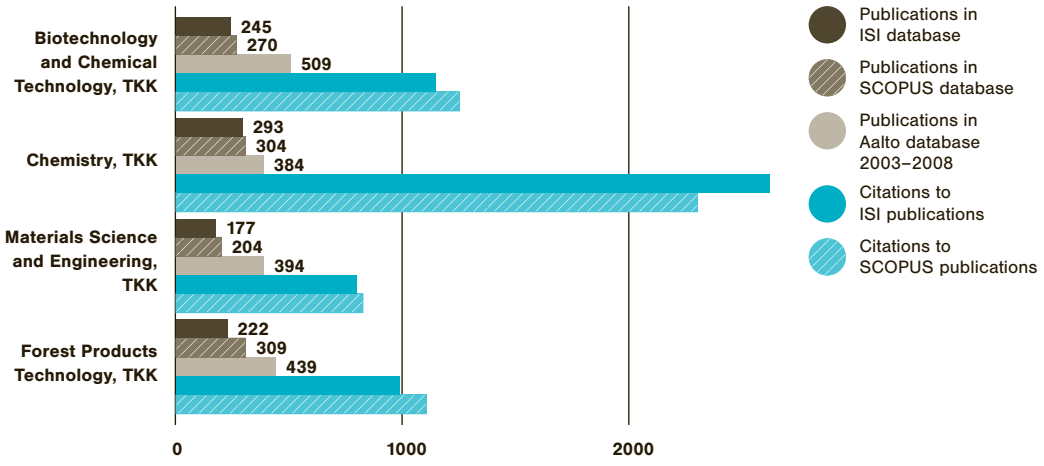


**Figure 5.1.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

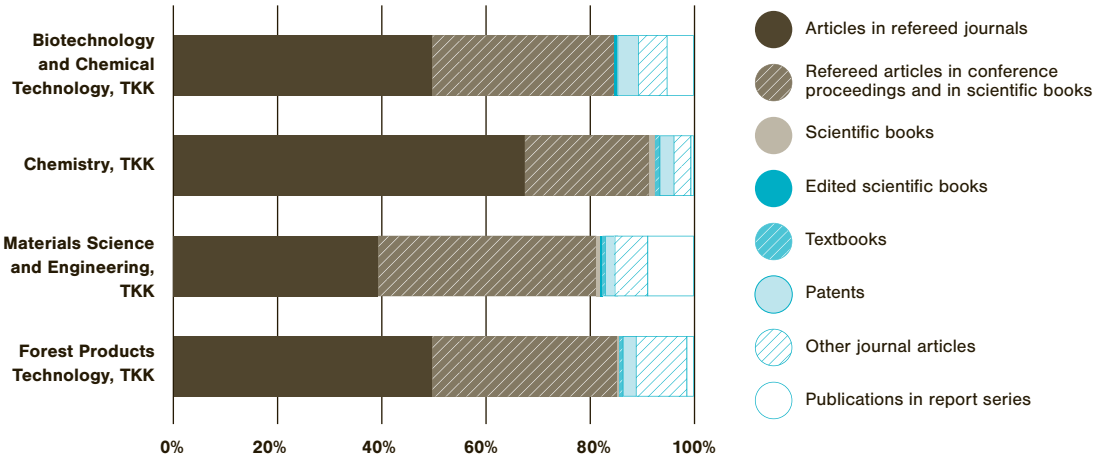


**Figure 5.1.4** Overall publication profiles 2003–2008.

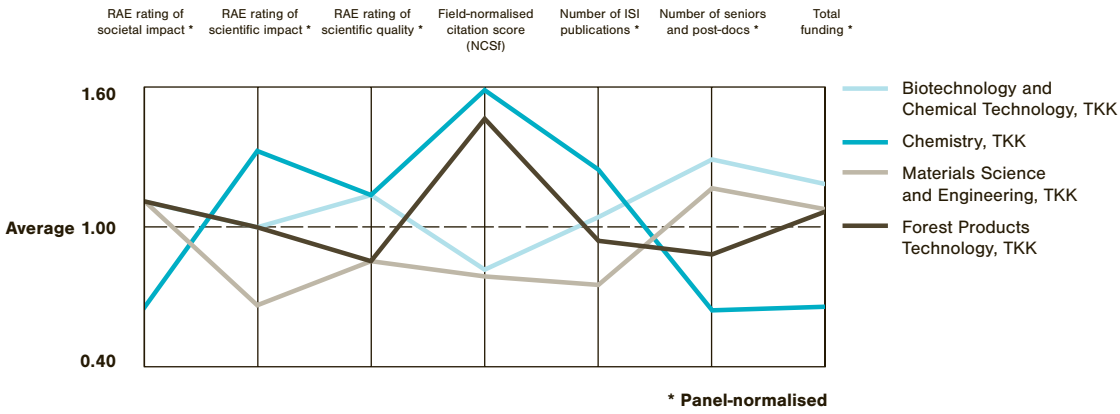


**Figure 5.1.5** Panel-normalised research indicators of the Units of Assessment in Panel 1 (1.0 is the average of the Panel). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Biotechnology and Chemical Technology, TKK

### *Introduction*

Areas of expertise in the Department of Biotechnology and Chemical Technology cover the complete chain from theory and experimental research to the practical process design skills needed in the chemical, forest, biotech, pharmaceutical and food industries and in production of new materials. The core skills are mastery of unit operations and processes, theory of mass and energy balances and the theory and practice of chemical and biochemical reactions. The research can be grouped in two main areas of Chemical Technology and Engineering and Industrial Biotechnology although the limits are not sharp and numerous cooperation projects exist. The key mission of the Department is to educate qualified engineers and Doctors of Science in technology based on excellence in research.

### *Summary of Panel Assessment*

The Unit has managed to define a clear and original focus for its research activities, with strong emphasis on relevance for and cooperation with industry in Finland and abroad. The well-defined strategic positioning of research at the Unit supports both high quality research (as evidenced by the very good publication record in top journals) and, in particular, the excellent societal impact of the Unit's research. However, while the emphasis on industry-related projects gives the Unit its characteristic identity as a fosterer of industrial innovations, the very same emphasis is threatening to turn the Unit too strongly towards industrial partners and away from the leading academic institutions in the field.

Nonetheless, the high quality of the Unit's research and the culture of publishing in high quality journals should make it relatively uncomplicated for the Unit to strengthen the status of basic science in industrially relevant areas in its research strategy by investing more on long-term foundational and high-risk basic research. Such a shift in strategy should contribute positively both to the international scientific visibility of the Unit and to the task of ensuring that the Unit preserves its capacity for original innovations.

### *Bibliometrics*

The Department of Biotechnology and Chemical Technology produces a good number of publications in journals with impact value 6 per cent above the global average. The field-normalised citation score NCSf of the Unit is, although close to the world average, relatively low at 0.82. The citation score reflects the relevance of research (or lack thereof) for the scientific community, which also according to the Panel Assessment is the area that remains clearly lower than the societal impact of the Unit's research. Thus, the results of the Bibliometric Analysis support the Panel's recommendation that in the future the Unit should seek to strengthen the scientific relevance of its research by emphasising issues that are at the heart of the debate within the international scientific community.

## Department of Chemistry, TKK

### *Introduction*

The Department of Chemistry covers the four fundamental chemistry disciplines: Organic Chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry. Traditionally the continuity of the high-level research has been ensured by thorough chemical education and close cooperation with relevant industries. The central focus of the activities of the Organic Chemistry laboratory is on natural product chemistry. Inorganic Chemistry group is one of the pioneers in the ALD (Atomic Layer Deposition) technology, invented in Finland in mid 1970s. A strong modelling tradition of transport problems is a characteristic feature of the Physical Chemistry group. In the Analytical Chemistry group the research is focused on luminescence and optical methods.

### *Summary of Panel Assessment*

The Unit's research is at the very good international level, as is the Unit's impact on international scientific community. These results are impressive achievements – and even more so given that the links between the four fundamental chemistry disciplines covered by the Unit are rather loose. Moreover, the number of senior research staff is quite low and, accordingly, in some core fields (notably in analytical chemistry) the research environment at the Unit is not at the level that the Unit's quality of research would deserve. Thus, the ability to attract and hire young, high-level international experts is the main future challenge for the Unit.

### *Bibliometrics*

The Bibliometric Analysis supports the Panel Assessment. The Unit publishes in very good journals (with on average 31 per cent higher citation impact than the world average in the field), the Unit's publications attract 43% more citations than articles on average in the same journals, and the field-normalised citation score is significantly above international average at 1.60. The Unit also has a relatively high proportion of their publications within the top 5% of the world-wide citation distribution in its field, which is an indicator of a notable impact on the Unit's research field. At the sub-departmental level, the organic chemistry group is in light of bibliometric analysis at the level of undoubted global excellence.

## Department of Materials Science and Engineering, TKK

### *Introduction*

The Department of Materials Science and Engineering has the main responsibility for materials research and education at TKK. Its focus is on metallic materials, their production, structure, properties and performance with an increasing emphasis on other materials such as silicon, electronic materials and coatings. The research of the department covers the whole production chain of inorganic materials: from raw materials to products and recycling, from materials synthesis to properties and performance. Current research is focused on the development of processing, properties and industrial applications of construction, functional and active materials.

### *Summary of Panel Assessment*

The Unit is well connected to the traditional Finnish metal industry and to the industrial representatives of the most recent trends in materials science, such as the nano-, functional and electronic materials. This allows the societal impact of the Unit's research to reach outstanding quality level. The recruiting of new professors to replace the retiring senior staff gives the Unit an opportunity to meet some of the Unit's main challenges and to internationalise its research environment, strengthen the role of basic science in the Unit's research portfolio and to move the focus from the classical areas of materials science in accordance with the international industrial demand. The Unit ought in particular to consider strengthening the basic science and internal cooperation by cluster hires or joint appointments with other departments. This kind of development would allow the Unit to reclaim its place in the forefront of international materials science community and, thereby, to ensure that the societal impact of the Unit's research remains outstanding also in the globalised world of tomorrow.

### *Bibliometrics*

The view of the Panel Assessment receives support from the Bibliometric Analysis. With the field-normalised citation impact of 0.79, the Unit is at the risk of starting to fall behind of the forefront of international materials science. Also, the somewhat low normalised journal citation score of 0.76 suggests that the Unit might want to consider its publication policy and target journals with higher citation impact. In general, the Unit ought to focus more on basic science and on the most topical issues in the international scientific debate without losing its characteristic strength in outstanding societal impact.

## Department of Forest Products Technology, TKK

### *Introduction*

The research at the Department of Forest Products Technology is focused on (i) the chemistry and physics of wood, wood fibres and their products (including nanomaterials and composites), (ii) the production processes of chemical and mechanical pulps, paper, paper products and prints, (iii) wood products, their production processes and value chains, and (iv) environmental technology in process industry, especially in forest industry. The Department has a unique national task in educating specialists for the future of the globalised Finnish forest sector. Together with KCL (Oy Keskuslaboratorio – Centrallaboratorium Ab, now part of VTT Technical Research Centre of Finland) and VTT, TKK forms a centre of higher education and research in forest products technology. Recently the department has responded to the rapid global changes and focused its research more in biorefining, biomaterials and their sustainable uses.

### *Summary of Panel Assessment*

The Unit benefits from good cooperation with the strong Finnish forest products industry, including extensive research and pilot facilities. This allows the Unit to offer an excellent research environment for its researchers. Similarly, the Unit can be considered to be among the leading international forest product research units in terms of the societal impact of its research. The Unit has also recognised the need to adapt to changing nature of forest industry by focusing strongly on the emerging areas of international scientific interest. The Department has also been successful in recruiting international staff members in recent years. If combined with increased collaboration between the various research groups within the Unit, the strategic re-positioning and internationalisation of the Unit can be expected to lead to a rise in high-quality publications in the near future. Success in this task is crucial for the Unit in order to retain its current position and reputation as an established and well-respected global player in its field.

### *Bibliometrics*

The vitality score of 1.14 indicates that the Unit's researchers use fairly recent references in their publications, which in turn suggests, as pointed out by the Panel, that the researchers are committed to focusing on new and emerging ideas. The Unit's publications receive on average more than 100% more citations than papers on average in the same journals, and the field-normalised citation score is also significantly above the world average at 1.47. However, the Unit should target higher impact journals, for the current publication outlets are very close to the global average in the field and the quality of the Unit's publications might warrant higher-impact publication channels. In summary, it seems that the Unit has managed to build on its past successes and to shift focus onto new, emerging and scientifically exciting areas.

# Panel 2: Electronics and Electrical Engineering

## Units of Assessment

**Department of Electronics,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Department of Radio Science and Engineering,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Department of Signal Processing and Acoustics,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Department of Electrical Engineering,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Metsähovi Radio Observatory,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

## Overview

Panel 2 sees the creation of Aalto University as a great opportunity for creating a truly international setting for reaching towards international excellence. The first step in this process should be to provide a transparent and international faculty recruitment policy. Currently the Units of Assessment stand out in international comparison by virtue of their shortage of international staff members. Internationalisation and gender balance should be major points of concern for the Units of Assessment in their quest for research excellence.

Further challenges for the Units of Assessment covered by Panel 2 include the position of postdoctoral researchers and inter-departmental cooperation. Currently the vagueness or outright non-existence of the career prospects of postdoctoral researchers is seriously demoralising their motivation for ambitious research. This is a problem Aalto University must resolve as soon as possible. The Panel also concludes that internal cooperation within TKK and Aalto University should be strongly encouraged. Some, currently isolated research groups should be brought into multidisciplinary collaboration with groups working on related issues. In this process some groups or individuals might even be relocated to different departments.

Internationally, the ISI Web of Science covers more than 50% of total

citations in the field of Electronics and Electrical Engineering.[16] This, and the fact that the number of ISI publications is clearly over 50 at all the Units of Assessment covered by Panel 2, entail that the ISI-based Aalto University Bibliometric Analysis can be concluded to cover the international research activities of these units rather well.

## Basic Data concerning the Units of Assessment

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

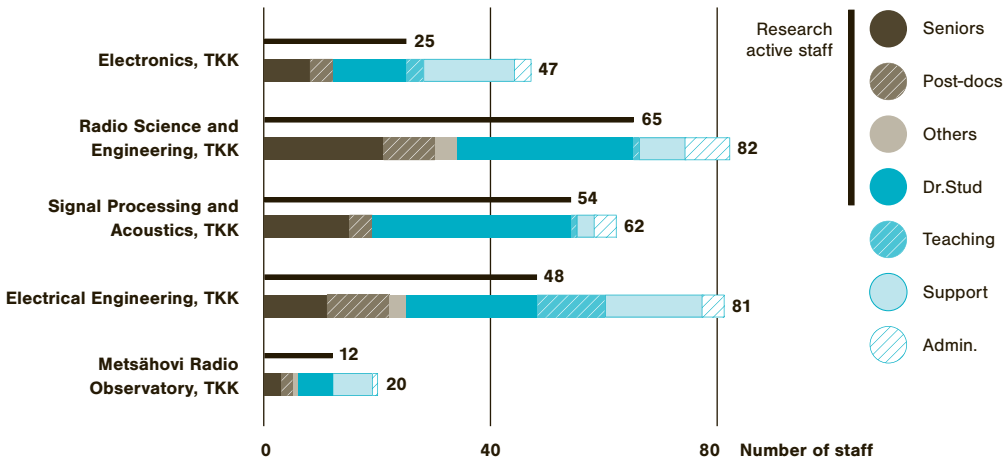


**Figure 5.2.1** Number of staff on the Aalto RAE census date of 1 October 2008.

16 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

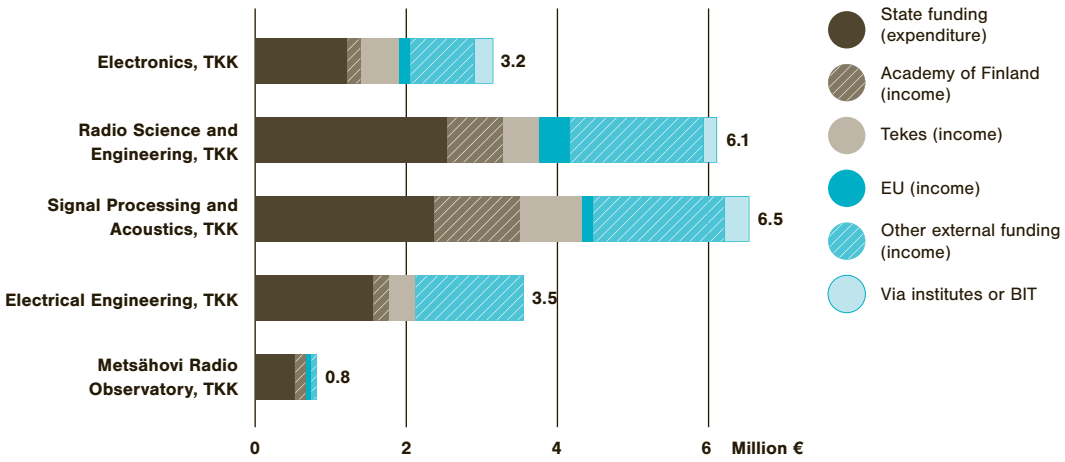


**Figure 5.2.2** Average annual funding during 2003–2008.

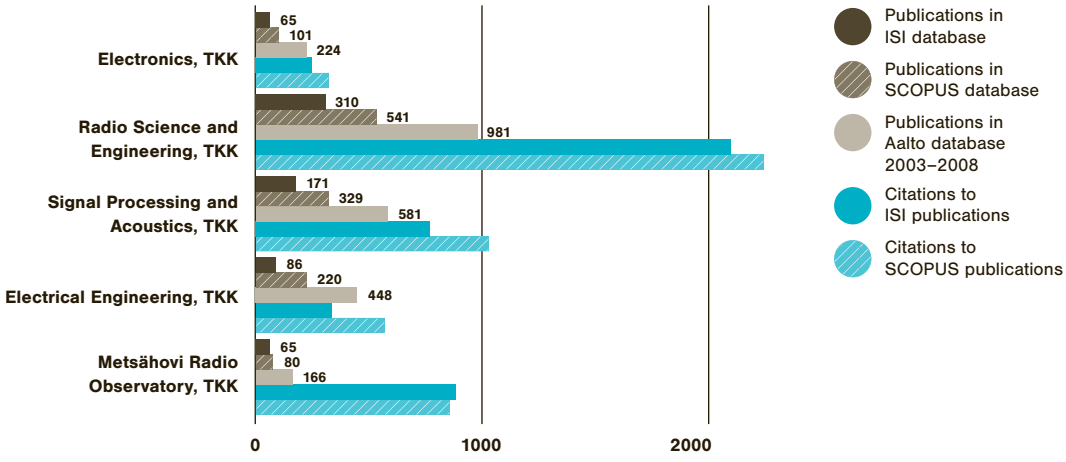


**Figure 5.2.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

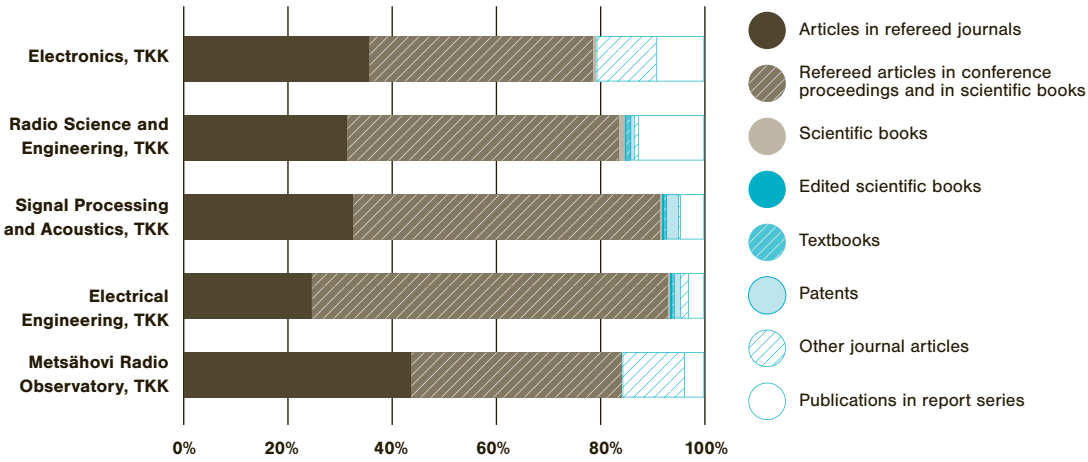


**Figure 5.2.4** Overall publication profiles 2003–2008.

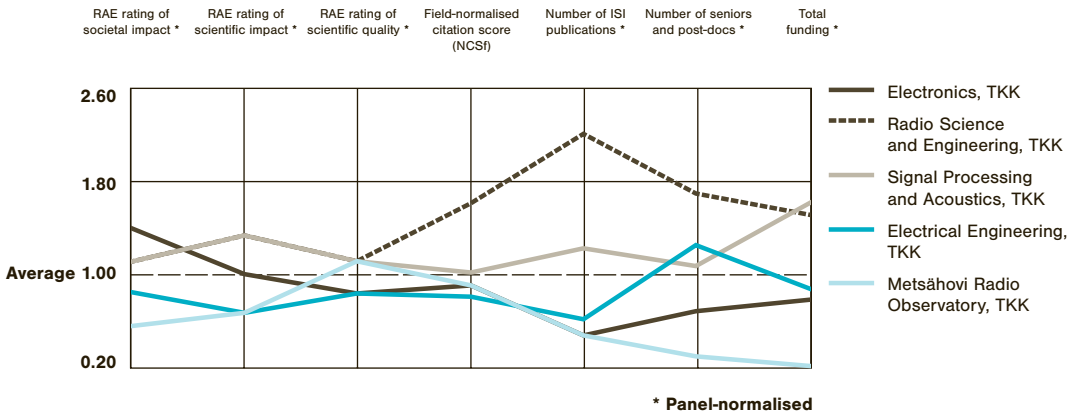


**Figure 5.2.5** Panel-normalised research indicators of the Units of Assessment in Panel 2 (1.0 is the average of Panel 2). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Electronics, TKK

### *Introduction*

The department of electronics was formed during spring 2008 by combining three individual laboratories (Lighting, Applied Electronics and Electronics Production Technology) together. The main fields of research at the department are (i) electronics for healthcare, medical research and support of elderly citizens, (ii) energy-efficient lighting solutions, LED lighting applications, light and human well-being, (iii) new reliable assembly technologies for electronics, and (iv) electronic systems and designs for national defence. The research strategy of the Department of Electronics is to combine basic and applied research of the selected focus areas.

### *Summary of Panel Assessment*

Three of the four laboratories that the Unit consists of are characterised by strong multidisciplinarity and outstanding societal impact of research. The level of research and the impact on the international scientific community of these laboratories are, on average, at the good international level, but the particular strength of these laboratories is the service to society. The fourth part of the Unit, the defence systems laboratory, is not integrated into the rest of the Unit and its energised, multidisciplinary and cooperative research activities. The main challenges of the Unit relate to the small number of senior research staff and the need to upgrade the scientific equipment of particularly the Applied Electronics group.

### *Bibliometrics*

The Unit's field-normalised citation score 0.91 is relatively close to the world average. The vitality score – the recency of cited literature – is high at 1.19, and although 50.3% of the Unit's publications receive no citations at all and the Unit has no papers in the top 5% of most cited articles in the field, the Unit's publications receive on average a full 160% more citations than papers on average in the same journals. This apparent contradiction may be partly explained by the fact that the average journal impact NJCS of 0.63 of the Unit's publication outlets is somewhat low in relation to other journals in the same field. Accordingly, the Unit ought perhaps to target higher impact journals.

## Department of Radio Science and Engineering, TKK

### *Introduction*

Research at the Department of Radio Science and Engineering focuses on understanding of the physics of electromagnetic waves (from radio to optical frequencies) and applying this for the benefit of the society. The Department consists of three research groups in Radio Engineering, two in Electromagnetics, one in Circuit Theory, and one in Space Technology. Circuit theory deals with the computer-aided modelling, simulation, synthesis, and design methods of electronic circuits. Electromagnetics concentrates on computational field analysis and on interaction of electromagnetic fields with matter. Radio engineering deals with the study, design, fabrication, measurements and simulation of high frequency circuits and antennas. The Space Technology research group concentrates on the development of spaceborne and airborne microwave remote sensing instruments and retrieval of characteristics of geophysical targets from spaceborne and airborne data.

### *Summary of Panel Assessment*

The research groups at the Unit produce high-quality research and work together well, forming thus a consistent unit. The recent process of forming a collective department out of separate laboratories may, however, have restrained the Unit's capacity for creating truly multidisciplinary links to other units across Aalto University. Nonetheless, the research at the Unit – in particular, at the space and airborne technology group – has managed to reach not only excellent quality but also excellent impact both on the international scientific community and society at large. The best groups at the department exhibit strong research leadership in their fields. The main challenge for the Unit is to define a long-term strategic research plan at the department level. In addition to guiding the research efforts, such a plan should seek to resolve the apparent gender imbalance and the unbalanced age profile of (senior) research staff.

### *Bibliometrics*

The field-normalised citation score of 1.62 supports the Panel's view that the Unit has a notable impact on international scientific community. Moreover, the facts that the Unit's articles are cited 96% more often than papers on average in the same journals, and that the Unit has managed to place a notable proportion (11.4%) of their publications within the top 5% of the world-wide citation distribution in its field, support the Panel's assessment that the best groups at the department demonstrate international research leadership. In terms of the bibliometric analysis the Unit is performing very well, and the Panel Assessment gives very good advice on how to strengthen the Unit further.

## Department of Signal Processing and Acoustics, TKK

### *Introduction*

The Department of Signal Processing and Acoustics comprises of three former laboratories: Laboratory of Signal Processing, Laboratory of Acoustics and Audio Signal Processing, and Metrology Research Institute. The Metrology Research Institute is a joint laboratory of TKK and MIKES (Centre for Metrology and Accreditation) and acts as the Finnish national standards laboratory for optical quantities. Research at the Department focuses on audio signal processing, communication acoustics, speech communication technology, signal processing for wireless communications, optical radiation measurements as well as sensor array and multi-channel signal processing. The industrial relevance of the research is very high and the research groups have close cooperation with several ICT and other high-tech companies. With the exception of the salaries of the permanent staff, the research of the Unit is funded completely by money that is applied for from outside the home university.

### *Summary of Panel Assessment*

Department of Signal Processing and Acoustics is a strong unit. The professors have clear visions of the strategic goals and challenges in their respective fields. However, a shared understanding of a common department-level long-term strategy and overall leadership appear to be missing at the Unit. Research at the Unit is of excellent international quality, and the same can be said about the scientific and societal impact of research. The Unit has very well established connections to the industry, and to academic research partners both across Aalto University (also in art and design fields) and internationally. The research performance of the Unit is already excellent, and if the Unit is successful in defining a long-term research strategy for the whole Unit, including effective overall leadership and active plans to attract foreign experts to join the Unit, the Unit can be expected to reach the highest international quality level in the near future.

### *Bibliometrics*

The Bibliometric Analysis gives further evidence of the picture of this Unit as a steady and reliable performer. The field-normalised citation score 1.02 is practically at the world average, and the other indicators can be seen to point at the same direction. The Unit's articles receive 32% more citations than papers on average in the same journals, but the Unit settles for publishing in journals with citation impacts on average 9% lower than the field's global reference value. Accordingly, the Unit could perhaps aim at sharpening its publication strategy.

## Department of Electrical Engineering, TKK

### *Introduction*

The Department of Electrical Engineering was formed in the beginning of 2008 by merging the Laboratory of Electromechanics, the Laboratory of Power Systems and High Voltage Engineering, and the Power Electronics Laboratory. The research within the Department is conducted in seven Research Groups. The main fields of research are Electric Drives, Electromechanics, High Voltage Engineering, Industrial Electronics, Power Electronics, Power Systems and Power Transmission.

### *Summary of Panel Assessment*

The professors at the Unit are highly competent and well respected in their special fields, which gives the Unit a solid scientific basis to build upon. However, despite having an engaged department chair, the Unit is still in the process of integrating into a consistent department. This may contribute to the fact that thus far the degree of inter- and multidisciplinary research is rather low even within the Unit, not to mention with other partners. The Assessment Panel felt that in the specific research field of the Unit, energy and power engineering, this lack of interdisciplinary cooperation is a particularly serious shortcoming, for the field is currently facing novel challenges and societal demands that can be addressed only by means of wide cooperation between different branches of learning. Thus, the Unit should aim for creating without delay a medium-to-long-term roadmap and strategic plan for the Unit's research activities to support a concerted effort to reorganise the existing research strengths into a form more suitable for addressing the new challenges of the research field that call for interdisciplinary solutions.

### *Bibliometrics*

The results of the Bibliometric Analysis support the view of the Panel, namely that while the Unit includes firm research expertise to build upon, the Unit might want to focus more on adjusting its research efforts to the most contemporary international debates and demands. The Unit's field-normalised citation score of 0.81 is close to the international average, but the researchers publish their work in journals with impact factors 28% below the world average in the field. Also the vitality score – the recency of cited literature – is somewhat low, and the Unit's share of papers in the top 5% of the field's most cited papers is similarly modest. Thus, the Unit might wish to sharpen its research strategy, including publication policy, to improve the Unit's standing in the forefront of research in its field.

## Metsähovi Radio Observatory, TKK

### *Introduction*

Metsähovi Radio Observatory is a separate research institute of TKK. It operates a radome-enclosed 13.7-metre diameter radio telescope at Metsähovi in the town of Kirkkonummi, about 35 km west from the TKK campus. Since the beginning of 2008, even though still maintaining its status as a separate research institute, Metsähovi is part of the Faculty of Electronics, Communications and Automation. As the only radio astronomical observatory in Finland, Metsähovi has a nationally important role. Metsähovi is active in the following fields: research in radio astronomy and multifrequency astronomy, development of instruments and methods for radio astronomical measurements, space research and education.

### *Summary of Panel Assessment*

The Unit is characterised by its small size that prevents it from being an important player in the international scientific community and from having a sizeable societal impact. The small size does not, however, prevent the Unit's researchers from carrying out high-quality research, published in high-impact international journals. Thus, although the quality of the Unit's research is at the very good international level, in terms of its size the Unit is below the critical mass. This weakness is accentuated by the Unit's isolated location and the fact that the Unit is not part of a larger department. The Assessment Panel concludes that with its capable researchers concentrating on fundamental research, the Unit could be an important asset for Aalto University if the Unit's inadequately small size is compensated by, for example, integrating the Unit into the Department of Radio Science and Engineering – or by allowing the Unit itself to grow much larger.

### *Bibliometrics*

The Bibliometric Analysis gives a picture of a Unit very close to the international average in terms of most of the indicators applied in the analysis. The notable exception is the very high international collaboration score 6.4 (the mean number of countries represented by the co-authors in the Unit's publications) and, in particular, the mean number of authors per paper 43.6. Although this may be rather typical for the field of research in question, it nonetheless confirms that the Unit has been successful in cooperative networking with international colleagues, which indeed is essential for an undersized unit such as the Metsähovi Radio Observatory. This emphasis on international cooperation might well be a major factor supporting the Unit in its struggle for maintaining an internationally comparable quality level with a clearly incomparable size.

# Panel 3: Mathematics and Physics

## Units of Assessment

**Department of Biomedical Engineering and Computational Science,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Mathematics and Systems Analysis,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Applied Physics,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Micro and Nanosciences,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Low Temperature Laboratory,**
Helsinki University of Technology (TKK)

## Overview

Research at the Units of Assessment covered by Panel 3 ranges from basic to applied physics, from elements of electrical and computational engineering to applied mathematics. In general, the quality of research at these units is in the view of the Panel rather strong, and some parts are of world-leading quality. However, the Panel notes that with the exception of the Department of Mathematics and Systems Analysis, the organisation of the units appears somewhat artificial in terms of clear disciplinary rationale. This creates a certain amount of fractionalisation, duplication and awkward positioning/ competing for resources.

A striking feature of the Units of Assessment is that a vast majority of the academic staff has studied and worked exclusively at the very same unit they are currently employed by. While this situation, exceptional as it is in international perspective, is rather common at Finnish universities, it most probably contributes to the inward-looking and isolated atmosphere one observes at these units. International experience should be a major requirement when hiring new faculty for Aalto University. Strengthened internationalisation at all levels is in the Panel's view a necessary condition for achieving true international visibility for Aalto University's research activities. The introduction of a tenure-track system can be expected to make Aalto University a more attractive employer for promising international recruits and to help to motivate the postdoctoral researchers who are currently frustrated by the lack of clear career opportunities.

The Panel also notes that many of the activities of the Units of Assessment in Panel 3 would benefit strongly from the establishment of rigorous research programmes in Life Sciences (especially Biotechnology, Molecular Biology and Genetics) at Aalto University.

Finally, Panel 3 covers disciplines where a bibliometric analysis based on the ISI Web of Science can be considered to be rather representative. Internationally, in different subfields of Physics journal publications receive approximately 90% of all citations, and ISI journals cover roughly 90% of these. In Neuroscience and Medicine the figures are even higher, whereas in Applied Mathematics the same figures are 70% and 77%, respectively.[17] Figures 5.3.3 and 5.3.4 confirm the importance of journal publications and the good ISI coverage also in the case of these Units of Assessment.

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

17 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, pp. 129-130.

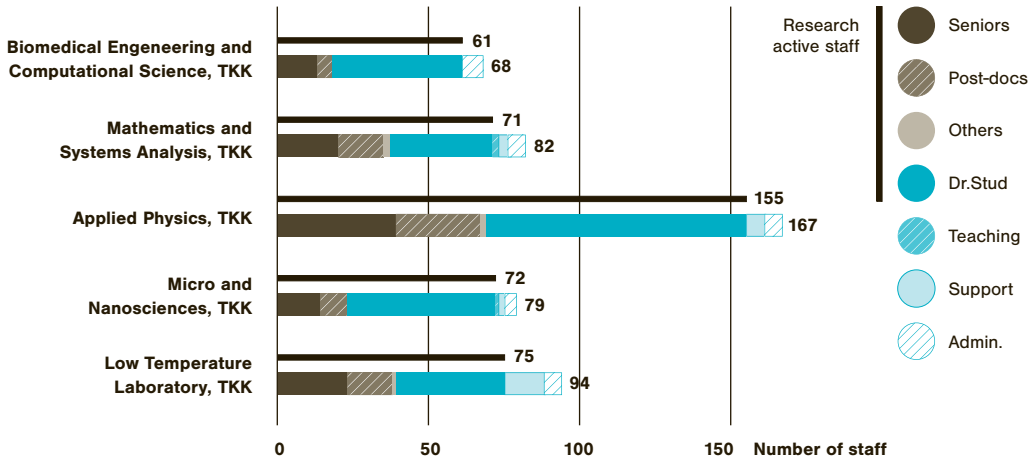


**Figure 5.3.1** Number of staff on the Aalto RAE census date of 1 October 2008.

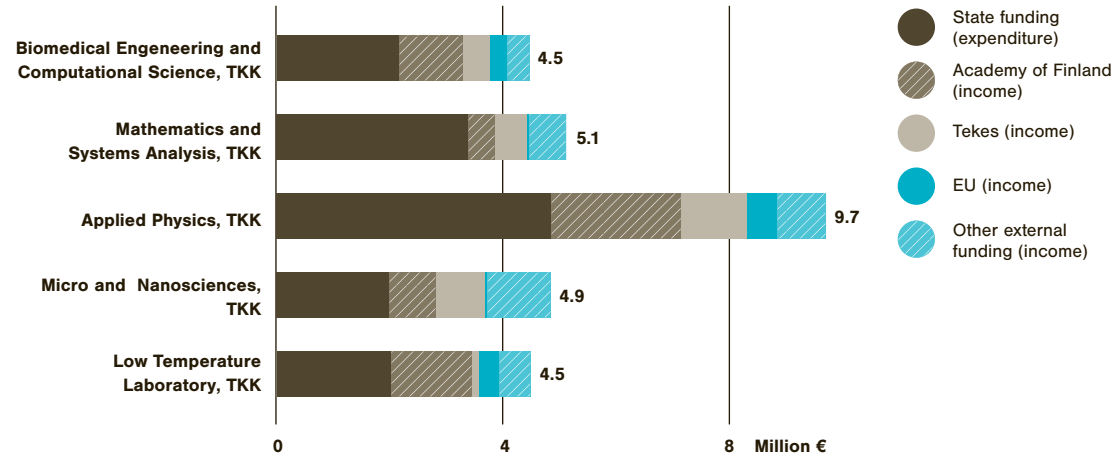


**Figure 5.3.2** Average annual funding during 2003–2008.

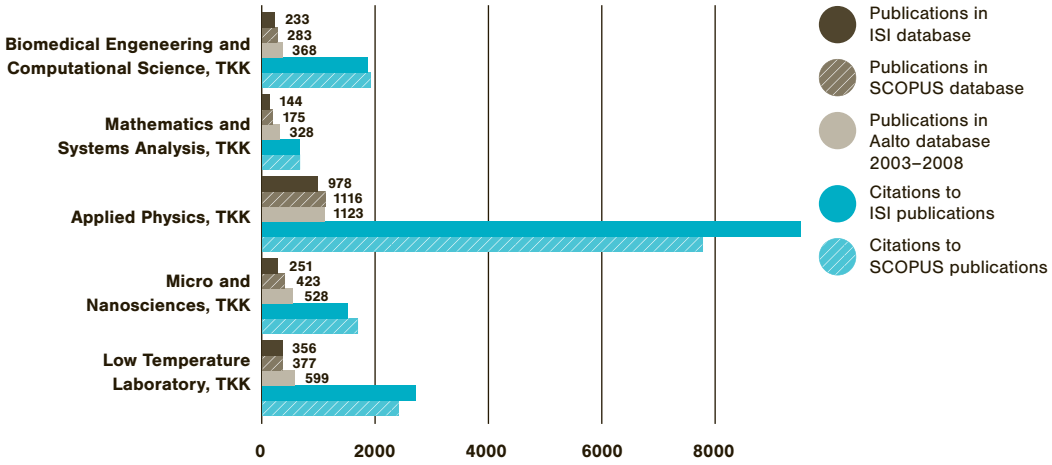


**Figure 5.3.3** Number of refereed international articles/conference papers in 2003-2007 and number of citations in 2003–2008.

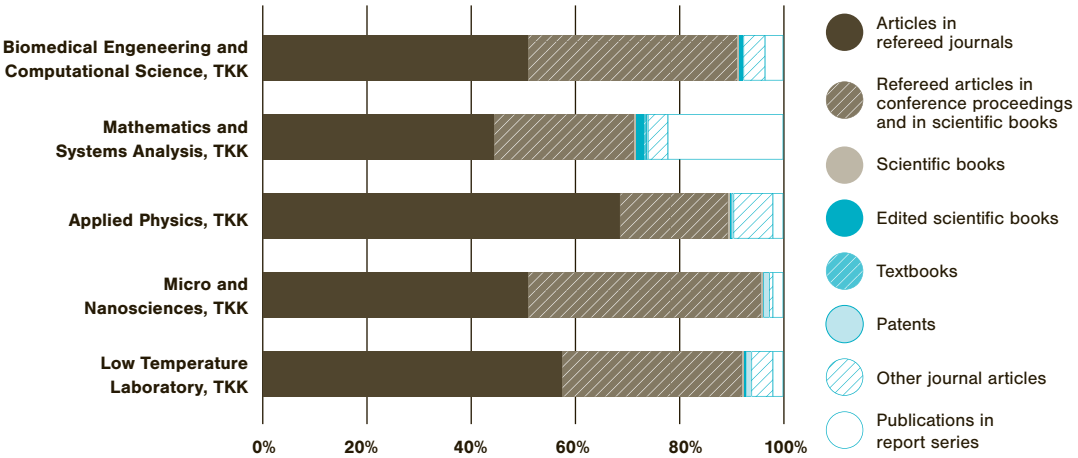


**Figure 5.3.4** Overall publication profiles 2003–2008.

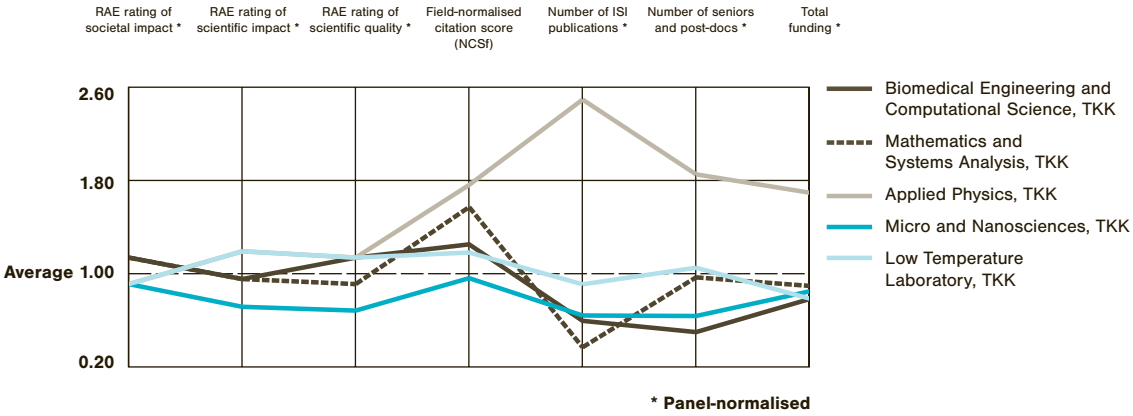


**Figure 5.3.5** Panel-normalised research indicators of the Units of Assessment in Panel 3 (1.0 is the average of Panel 3). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Biomedical Engineering and Computational Science, TKK

### *Introduction*

The Department of Biomedical Engineering and Computational Science was formed in January 2008 by fusing the Laboratory of Biomedical Engineering and the Laboratory of Computational Engineering. The main research fields of the Department are: 1) Computational Science, including Computational Health and well-being (eHEALTH) and Complexity (systems and networks), 2) Brain and cardiac imaging, monitoring, and therapeutic technologies including MEG-MRI, MCG/ECG, TMS, NIRS, signal analysis and modeling, 3) Fundamental Science, incl. physics, biophysics, computational statistics, statistical physics and information theory, neuroscience and psychology.

### *Summary of Panel Assessment*

The two main research areas of this creative and productive Unit, (i) computational science and (ii) bioelectromagnetism instrumentation and brain function analysis, form a unique combination that gives a promise of original innovations. Research in both main areas is of very high international quality, leading to an impressive number of high-quality and high-impact publications. Both areas are also exploring possibilities for innovative collaboration with researchers from HSE, TaiK and TKK. Although the scientific impact of the Unit's research is similarly impressive, as testified by e.g. the amount of well-known and highly cited articles and the securing of the status of national Centre of Excellence etc., in the view of the Assessment Panel the societal impact of the Unit's research is even more exemplary in international comparison.

The Unit's research has all the ingredients required for becoming a flagship of Aalto University's research in the near future and for leading Aalto University's expansion into Life Sciences. To support this development, the Unit ought to establish even more bridges between the two main research areas of the Unit and better collaboration with the Brain Research Unit of the Low Temperature Laboratory. Even a merger with this unit should be carefully considered.

### *Bibliometrics*

The research performance of the Department of Biomedical Engineering and Computational Science is very good. The field-normalised citation score NCSf 1.25 is significantly above the international average, the vitality score (the recency of cited literature) is quite high and the average impact of the Unit's publication outlets is reasonably prominent as well. The indicators used in the Bibliometric Analysis point towards a solid, respectable performance.

## Department of Mathematics and Systems Analysis, TKK

### *Introduction*

The Department of Mathematics and Systems Analysis consists of two formerly separate components, the Institute of Mathematics and the Systems Analysis Laboratory. The main research fields represent a wide spectrum from abstract questions to applications. These are 1) mathematical analysis (geometric analysis, harmonic analysis, inverse problems, operator theory, partial differential equations), 2) numerical analysis (numerical linear algebra, finite element methods, dynamical systems, computational mechanics), 3) stochastic analysis (mathematical finance, probability theory), and 4) systems and operations research (game theory, optimisation, simulation, risk analysis, decision support systems, forecasting). The Unit aims at being a world-class research centre in mathematics with particular focus on applications in engineering, environmental issues, and mathematical scientific computing.

### *Summary of Panel Assessment*

This is a high-quality research unit that stands out among mathematics departments across the world in virtue of its ability to attract external funding and to engage even the students in concrete, applied projects originating from the needs of the Unit's non-academic partners. While the Panel considers the scientific quality and impact of the Unit's research to be at the very good international level, and the societal impact of research to be outstanding, the Panel is concerned by the somewhat narrow focus on applied mathematics. Widening the Unit's research profile to pure mathematics and to some currently neglected areas of applied mathematics (such as statistics and discrete mathematics) might make it easier for the Unit to develop its already notable scientific quality and impact into the world-leading level. Mathematics departments in leading universities of the same size as Aalto University tend to have much larger mathematics departments. In addition to small size, a related obstacle for the task of raising the research quality even higher is the heavy teaching load of the Unit's researchers. Moreover, as is the case with most Aalto University units, the Department of Mathematics must focus on internationalising its research environment and seek to recruit more researchers from abroad.

### *Bibliometrics*

The field-normalised citation index NCSf of the Department of Mathematics and Systems Analysis is significantly above international average at 1.57. The Unit targets high-impact journals (17% above the field average) and the Unit has succeeded in placing 11.4% of its publications into the top 5% of most cited publications in its field. The Unit's overall journal-normalised citation score is also very good at 1.44. The research performance of the Unit is in general very impressive, which gives a very good basis to build on.

## Department of Applied Physics, TKK

### *Introduction*

The present organisation of the Department of Applied Physics was established in 2008 as part of the general restructuring of the University. The research activities in the Department are mainly focussed around condensed-matter and materials physics, with important additional activities in quantum and nano-optics as well as advanced energy systems. The research is carried out in 17 research groups. The Department has research activity in the following fields: theoretical and computational physics, experimental surface science and materials characterisation, nanomaterials synthesis and processing, optics, soft and self-assembled molecular materials, nanomagnetism and spintronics, new and renewable energy systems, including fission/fusion physics.

### *Summary of Panel Assessment*

The Assessment Panel considers the overall performance of the Department of Applied Physics to have the potential for being a role model within Aalto University with respect to international scientific visibility and impact: both the quality of research and the impact on the international scientific community are at the highest, outstanding international level. While the societal impact of the research carried out at the Unit is also very good in international comparison, the truly outstanding research quality and scientific impact create potential for further improvement in this respect both nationally and internationally.

The exceptional scientific quality of the Unit's research is made possible and well supported by the outstanding research environment the Unit is able to offer for its researchers. The professors of the Unit are scientific leaders in their field and thus they have managed to attract a notable number of foreign researchers to work at the Unit. Despite the climate of uncertainty created by the highlighted role of short-term research grant support, the Unit has succeeded in creating a research environment that in the view of the Assessment Panel is fully comparable to the best departments across the world in terms of research management, environment and infrastructure. The Panel noted that there is a considerable overlap in the scientific activities of the Unit and the Department of Micro and Nanosciences (especially within the Micronova Lab); a rethinking of the departmental strategy in this respect might strengthen further the Aalto University research environment in this important field.

In summary, the Unit has a healthy age distribution among professors, a very ambitious atmosphere, and when the Unit defines a far-sighted and coherent strategic research plan the Unit has the potential to establish a leading international role in all of its major research areas. With the introduction of a tenure-track system for research staff and an increase of administrative support, the Department of Applied Physics can be expected to be a flagship of Aalto University research in the foreseeable future.

*Bibliometrics*

The research performance of the Department of Applied Physics is very impressive. The field-normalised citation score NCSf for the whole department, 1.76, is considerably above the international average and falls only very little from reaching the very strong international level. At the sub-departmental level, the Nanomaterials Group is in terms of bibliometrics at the level of undoubted global excellence, while the Molecular Materials Group and the Quantum Dynamics Group function at the very strong international level. The Unit publishes in high-impact journals (38% above the global reference value), and the Unit's publications receive 37% more citations than other articles in the same journals. 13.2% of the Unit's publications fit into the top 5% of most cited articles in the field, and the vitality score (the recency of cited literature) 1.22 is also very high. These indicators give evidence of strong international leadership at the forefront of the Unit's research field.

**Department of Micro and Nanosciences, TKK**

*Introduction*

The Department of Micro and Nanosciences (MNT) was established during the recent reorganising of TKK in January 2008. The department consists of eight research groups: Electron Physics (EPG), Electronic Circuit Design (ECD), Fiber Optics (FOG), Micro and Quantum Systems (MQS), Microfabrication (MFG), Nanotechnology (NTG), Optoelectronics (OEG) and Photonics (PG). Excluding the largest, i.e. the ECD -group, the Unit resides in Micronova, a research centre for microelectronics and nanotechnology. Micronova is jointly run by TKK and VTT (Technical Research Centre of Finland).

*Summary of Panel Assessment*

The scientific quality and impact of the research groups is, on average, good, while their societal impact has reached the very good international level, thanks mainly to the strong cooperation with industry. Also the direct connection to VTT supports the impact of the Unit. Merging eight research groups into a single department is a relatively recent development, and thus far the newly-formed Unit has not been able to form a strong identity as a coherent department over and above the disparate research groups. However, the Unit has several unique strengths that could be used to develop the Unit into a world-class research unit. In particular, the Micronova facilities, including clean rooms, are among the best in the Nordic countries. Similarly, the collaboration with industry in general and VTT in particular is already at very good level. The Unit also has excellent technical support staff.

With a well-developed strategic vision, the Unit has a good potential to grow from its present, somewhat fractured state into an established research unit. Also the division of labour between the Unit and the Department of Applied Physics and other units might benefit from being rethought.

*Bibliometrics*

The bibliometric indicators give a picture of a Unit pretty close to the international average in its field. This appears to be in agreement with the Panel Assessment: The opportunities offered by the Unit's state-of-the-art research environment and industrial connections have not yet been translated into excellence in terms of the quality and scientific impact of research at the Unit. In terms of the Bibliometric Analysis the Unit has not yet realised its full potential.

**Low Temperature Laboratory, TKK**

*Introduction*

Low Temperature Laboratory was founded in 1965 and became an independent TKK research institute in 1973. The main research fields are ultra-low temperature physics (20%), systems-level neuroscience (45%) and low temperature quantum electronics (30%), started in 1965, 1980, and 1996, respectively. The Physics Research Unit combines ultra-low temperature physics and low temperature quantum electronics. The research in the Physics Research Unit is conducted by five experimental groups, supported by theory and technical service groups. The activities of the Brain Research Unit are divided into four research groups and one technical support group.

*Summary of Panel Assessment*

The Unit is among world-wide leaders in all of its main research areas (ultralow temperature physics (presently mostly liq./sol. He), neuroscience (presently mostly brain research) and quantum electronics (presently mostly nano- and microelectronics)) and, correspondingly, the name of the Low Temperature Laboratory is an internationally well-known and trusted trademark. In all these main areas both the quality and scientific impact of research is outstanding in international comparison.

The Assessment Panel considers the Physics Research Unit of the Low Temperature Laboratory to be "the world-leader, or at least among the top 3", in four research areas and the Brain Research Unit in a world-wide outstanding position in two research areas. Accordingly, members of the Low Temperature Laboratory have an exceptionally impressive publication and citation record in top journals. The Unit has been very successful in attracting research funding, national and international centres of excellence, top-quality visiting international scientists and capable research students. The societal impact of the Unit's research is at the very good international level. The Unit has a good record in start-up companies and an established collaboration with industry and the public sector.

With its partly unique and home-built equipment, highly qualified staff and numerous international cooperation networks the Low Temperature Laboratory has the potential to be among the flagships of Aalto University's research, especially if more administrative support (grant and budget

management in particular) is offered to the Unit. The Panel also recommends increased integration with other TKK and Aalto University units, including getting more involved in teaching activities, and a possible merger with the Department of Biomedical Engineering and Computational Science. Finally, by combining research of internationally leading quality with topics that are equally fascinating for laymen, the Low Temperature Laboratory has also the potential to be in the forefront of popularising Aalto University's research for public at large.

### *Bibliometrics*

The Low Temperature Laboratory has for decades been among the internationally most well-known brand names of TKK, and this reputation is reconfirmed by the Panel Assessment. The Bibliometric Analysis 2003–2007 gives a picture of a Unit that publishes its results in very high-impact outlets (on average 41% above the global reference value of the field), but the field-normalised citation score of which remains close to the international average at 1.18. This suggests that in order to maintain its position as a global leader in the increasing international competition within its research field, the Unit cannot neglect developing further the quality and impact of its research activities.

# Panel 4: Computer Science and Information Technology

## Units of Assessment

**Department of Media Technology,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Computer Science and Engineering,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Information and Computer Science,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Communications and Networking**,
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

**Helsinki Institute for Information Technology (HIIT),**
Helsinki University of Technology (TKK)

## Overview

The units evaluated by Panel 4 are engaged in high-quality research characterised by close and extensive cooperation with industry. Researchers at all levels are highly motivated and find the research environment stimulating, although the lack of clear career paths is seen as a problem at the Units of Assessment. There is a strong emphasis on interdisciplinary research, which should make it relatively easy to exploit new multidisciplinary possibilities offered by the creation of Aalto University. The Panel observed particular synergy potential in the future cooperation between the Department of Media Technology and TaiK on the one hand, and the Department of Computer Science and Engineering and HSE on the other.

Most of the Departments have been formed only recently on the basis of laboratories with much longer research traditions. Accordingly, some Units of Assessment have not yet managed to define a shared, department-level vision for research activities, and in general department-level leadership was lacking at some units. The dominance of short-term applied research projects is further complicating the efforts to set a long-term research agenda for the units. These problems are reflected in the fact that the visibility and branding of the departments within the international scientific community remains in most cases underdeveloped. This, in turn, may make it more difficult to attract high-level researchers and doctoral students from abroad to the units.

A further organisational concern arises from the fact that while the Panel understood the rationale behind placing these five units into the same Panel, the units are in fact located at two different faculties at TKK. Together the five Units of Assessment might form a coherent Faculty of Information Technology.

Figures 5.4.3 and 5.4.4 imply that the ISI Web of Science, on which the Aalto University Bibliometric Analysis is based, does not cover very comprehensively the research outputs of the Units of Assessments in this Panel. This is because the ISI database's coverage of conference papers is rather limited, and conference publications play a notable role in the fast advancing fields of computer science and information technology. Accordingly, the Panel highlights the importance of conference publications and warns Aalto University against concentrating exclusively on journal publications in these fields. However, in more theoretically oriented computer science 45% of all citations are to journal publications, and ISI covers 70% of these,[18] which indicates the importance of ISI publications for scientific impact and visibility within the international scientific community. Moreover, the most important bibliometric indicator applied in the Aalto University Bibliometric Analysis, NCSf, is explicitly a field-normalised citation indicator.

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

18 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

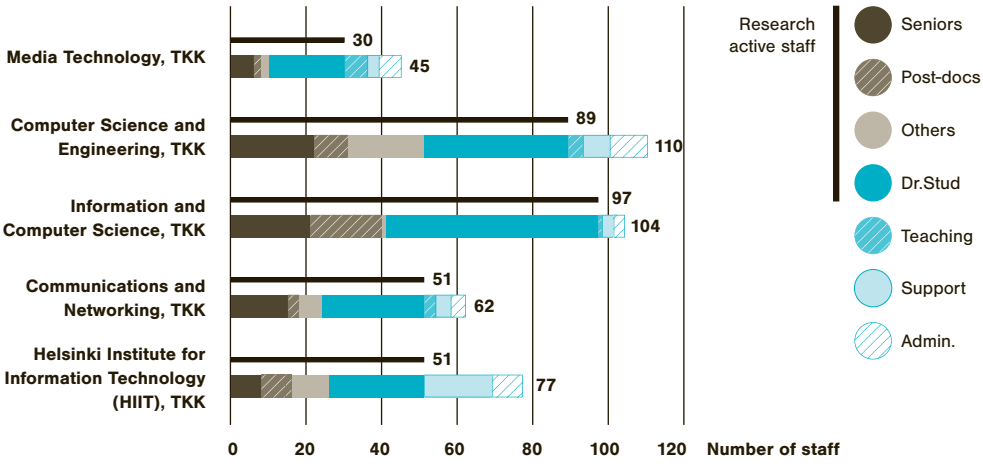


**Figure 5.4.1** Number of staff on the Aalto RAE census date of 1 October 2008.

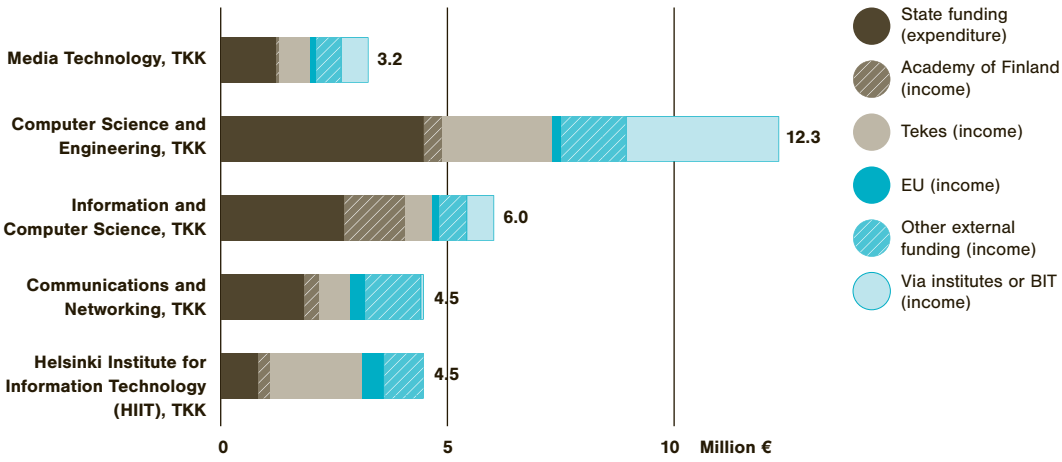


**Figure 5.4.2** Average annual funding during 2003–2008.

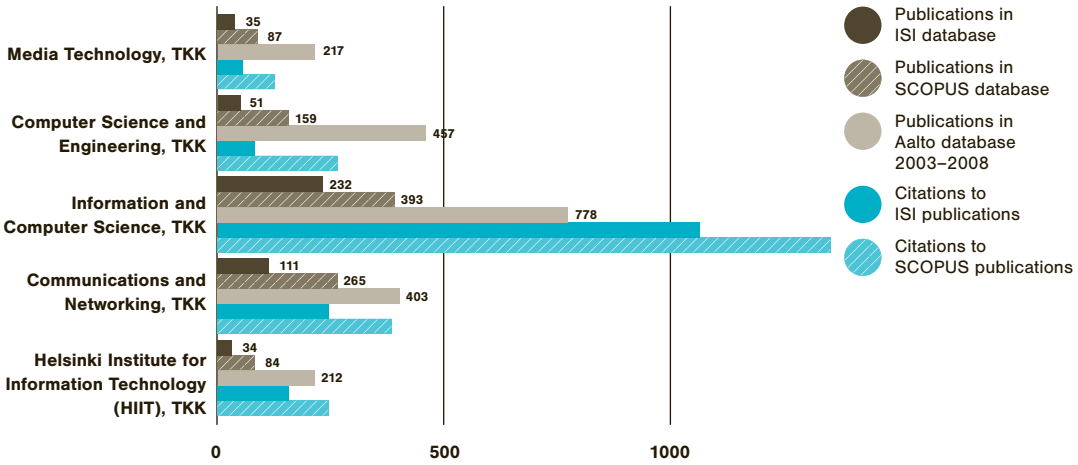


**Figure 5.4.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

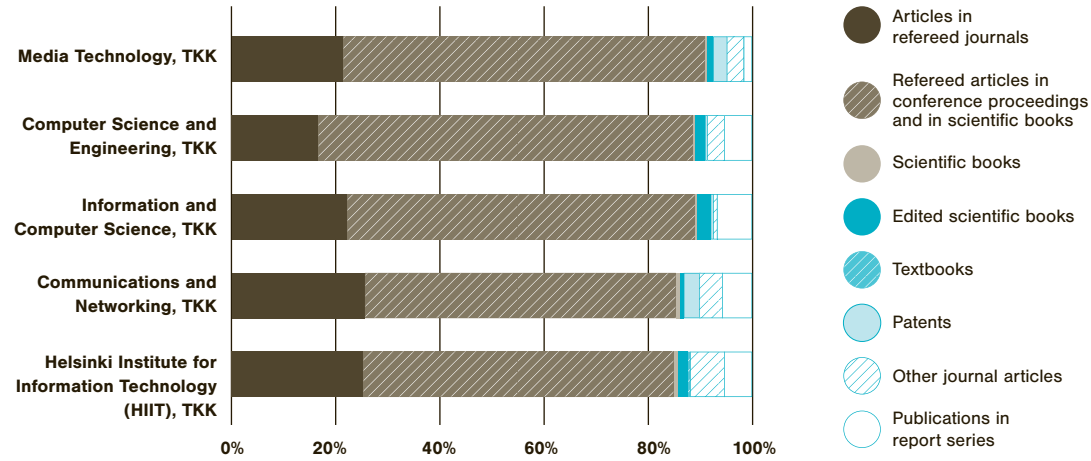


**Figure 5.4.4** Overall publication profiles 2003–2008.

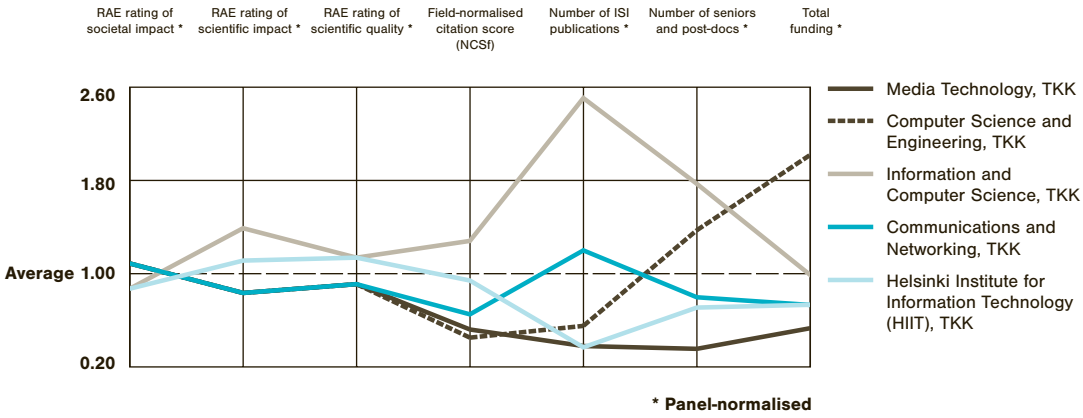


**Figure 5.4.5** Panel-normalised research indicators of the Units of Assessment in Panel 4 (1.0 is the average of Panel 4). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Media Technology, TKK

### *Introduction*

The Department of Media Technology was established in the reorganisation of TKK in the beginning of 2008. It was formed of two laboratories: the multimedia part of the Telecommunications Software and Multimedia Laboratory (TML) and the Laboratory of Media Technology. Most important research areas of the department are Digital Imaging (image quality, image capture, display and printing, computer graphics), Virtual Reality (modeling, imaging, interaction, virtual acoustics), Interactive Technologies (multimodal interfaces, computer vision), User Experience (usability, perception of media), WWW (semantic web, ontologies, web services and applications), Cultural Context and Concept Creation (artistic applications, cultural heritage).

### *Summary of Panel Assessment*

The activities of the Unit combine media, art and IT to create innovative and artistic artefacts and experience, supported by elements of scientific research. While the Unit's research emphasis is on novel innovations and on supporting artistic activities rather than on traditional scientific research, the quality of research at the Unit is nonetheless at the very good international level. The scientific impact of the Unit is also good, although, given the mentioned emphasis, an important part of the Unit's research activities cannot be fully captured by traditional scientific measures.

Where the Unit's research activities truly excel is the societal impact of research. The impressive track record in joint projects with industry, spin-off companies, patents, open-source software and invitations to serve in government committees give proof of outstanding societal impact. However, the lack of long-term research vision and the fact that the size of the Unit is below the critical mass expected from a top-quality research unit are currently obstructing the Unit's rise to the international forefront of research. Perhaps the creation of Aalto University will strengthen the collaboration between the Unit and similar groups at TaiK, contributing thereby to the partial resolution of these problems.

### *Bibliometrics*

As the Panel concludes, the Unit's main focus is not on conventional research aiming at journal publications. Accordingly, the number of the Unit's ISI publications, 36, is quite low, which undermines the reliability of the Bibliometric Analysis: it cannot be expected to give a comprehensive picture of the Unit's research activities.

While the Unit's field-normalised citation score 0.52 remains low and the Bibliometric Analysis shows that the Unit publishes in journals close to the field's global reference value, the vitality score (the recency of cited literature) of the Unit's publications is notably high, as can be expected from a unit in a fast-developing field. While the very high proportion of non-cited papers among the Unit's publications may be typical for the field in question,

the low journal-normalised citation score 0.39 suggests that even within its field the scientific articles of the Unit fail to acquire notable visibility. This supports the Panel's view that the scientific impact of research does not match the quality of research the Panel identified at the Unit and that raising the Unit's scientific impact on the scientific community would require long-term strategic work and commitment.

## Department of Computer Science and Engineering, TKK

### *Introduction*

The Department of Computer Science and Engineering (CSE) was formed in the recent TKK reorganisation in 2008. It consists of three major laboratories: Software Business and Engineering Institute (SoberIT), Data Communications Software and Software Technology, and a smaller research unit, SimLab. SoberIT was established in 2000 to do research in areas where the core problems lie largely outside the classical Computer Science needing a multidisciplinary approach. Data Communications Software was established in 1995 as part of the Telecommunications Software and Multimedia lab, to answer the demand for software engineers and Internet expertise in the telecommunications industry. Software Technology consists of a tight network of several smaller groups with focused research interests. SimLab conducts multidisciplinary research projects in the field of networked business processes and business models, with a special emphasis on collaborative development and innovation.

### *Summary of Panel Assessment*

The fact that the Department of Computer Science and Engineering is split between two locations is currently hindering the efforts to get the Unit to function smoothly as a coherent department. The Unit has successfully produced internationally recognised contributions to computer science research and the research at the Unit can be considered to be at the very good international quality level. However, although the Unit has managed to place its recent doctoral graduates to quite impressive positions within and outside Finland, and although the Unit's researchers participate in a number of international research programmes and projects, the scientific impact of the Unit is somewhat lower at the good international level. This is possibly due to the fact that the Unit has an overtly applied research profile: the Unit's research activities focus largely on producing concrete results that are directly useful to industry and the public sector. Accordingly, the societal impact of the Unit's research can be considered to be at the highest, outstanding international level. To realise the existing potential for a more notable scientific impact on its research field, the Unit ought to define a shared department-level long-term research vision. Also gathering the different research groups under one roof would surely help in this process.

*Bibliometrics*

The field-normalised citation score of the Unit (NCSf) 0.45 is significantly below the international average, and the other bibliometric indicators point towards the same direction. However, in the case of the Department of Computer Science and Engineering and indeed in the case of all the units in Panel 4, the ISI Web of Science database, on which the Bibliometric Analysis is based, covers a very limited part of the Unit's publications (and captures only a limited number of factual citations). Together with the applied emphasis discussed by the Assessment Panel this entails that the indicators based on the citation impact in ISI journals may be somewhat misleading in this case and the Panel Assessment gives more reliable picture of the Unit's research activities. However, the number of Unit's ISI publications (51) does warrant the use of field-normalised indicators.

**Department of Information and Computer Science, TKK**

*Introduction*

The Department of Information and Computer Science was established in January 2008 and comprises two former TKK laboratories: the Laboratory of Computer and Information Science and the Laboratory for Theoretical Computer Science. The Department's mission is to provide world-class research and education in the advanced computational methods required by modern science, engineering and society. A core aspect of this mission is the development of fundamental computer science methods for the analysis of large and high-dimensional data sets, and for the modelling and design of complex software, networking and other computational systems. Digitalisation is a strong priority on the research agenda of the Department.

*Summary of Panel Assessment*

The glue combining the two laboratories into a coherent department is the shared emphasis on mathematical methods in computation and joint research seminars. The merger into a common Unit has been successful: the department has a clear vision, long-term research plans and a solid financial basis. Together with excellent facilities, this well-managed department can offer an outstanding research environment comparable to the best units in the world. Accordingly, the Panel considers the research quality of the Unit to be at the highest, outstanding international level. The Assessment Panel concludes that "the department is one of the top five centres in the world in their research area".

The research results are regularly published on the best international forums and the publications receive an impressive number of citations. The Unit has been able to host several national centres of excellence, to attract a convincing amount of EU funding and the faculty has received several prestigious international research awards. Thus, also the scientific impact of the Unit's research can be considered to be at the highest, outstanding international quality level. The societal impact of research is very good in

international comparison: the department cooperates actively with leading global companies, has generated a number of spin-off companies and patents. The Unit has also been successful in placing its doctoral graduates into good positions within and outside the academia. With the introduction of a tenure-track system and even further internationalisation of the research environment, the Unit has the potential to become one of the flagships of Aalto University's research in the near future.

*Bibliometrics*

Despite the fact that ISI journals are arguably not as important for the academic disciplines represented by the units in Panel 4 as they are for some other subjects, the field-normalised indicators seem to give a picture quite similar to the Panel Assessment. Department of Information and Computer Science has a field-normalised citation score 1.28, which is significantly above the international average in the field. A particularly impressive indicator is the Unit's journal-normalised citation score NCSj, which is 51% above the international reference value. These values would be even more impressive for the Unit's Theoretical Computer Science Group, although it should be remembered that for this group ISI journals might form a more natural channel for disseminating the research results than for most other branches of computer science. Be that as it may, the Unit's research performance can be considered to be outstanding.

**Department of Communications and Networking, TKK**

*Introduction*

The Department of Communications and Networking (Comnet) was formed in the beginning of the year 2008 by merging two laboratories, Communications Laboratory (Comlab) and Networking Laboratory (Netlab). The directions of research at the department can be roughly divided into four main areas (without sharp boundaries) which are (i) wireless communications systems, from the physical layer and basic communications theory to the radio resource management, (ii) networking, including future Internet, metro Ethernet, delay tolerant networking, routing, signaling, protocols and applications, (iii) mathematical methods in telecommunications, including information and coding theory, as well as teletraffic theory and performance analysis with applications across the whole field, and (iv) network economics, including technology investments, technology adoption, ecosystem analysis, and regulation.

*Summary of Panel Assessment*

The scientific quality of the research at the Unit and its professors is very good. Many of the research projects at the Unit are at the forefront of research, and the researchers are able to publish their outputs in leading journals and conferences, and the publications attract a decent number of citations. However, output rate of these high-quality papers is on the lower

side. Hence, the Panel considers the scientific impact of research to be at the good international level.

In addition to producing more research outputs, the Unit should seek to establish a more visible place in the international scientific community, e.g. by being more active in organising high-profile conferences and by investing more effort on basic research. The quality of the professors and their publications is at the level that would substantiate such an enhancement of international profile. As one might expect from the Unit that has played a significant role in the development of the prominent Finnish telecom industry, the societal impact of the Unit's research is in the view of the Assessment Panel already at the highest, outstanding international level.

*Bibliometrics*

The Bibliometric Analysis appears to confirm the Panel's view that the Unit has not focused on developing the scientific impact of its research. The field-normalised citation score (NCSf) 0.65 struggles to reach the international average within the field, as does the journal-normalised citation score NCSj, currently at 0.68. Although the ISI Web of Science database, on which the Bibliometric Analysis is based, is presently less representative in the Unit's field of research than e.g. the Scopus database, the field- and journal-normalised scores nonetheless suggest that investing more on high-profile journal publications could be one way of increasing the Unit's impact on and visibility within the international scientific community.

**Helsinki Institute for Information Technology (HIIT), TKK**

*Introduction*

The Helsinki Institute for Information Technology (HIIT) is a joint research institute of the University of Helsinki (UH) and Helsinki University of Technology (TKK). HIIT was founded in 1999. HIIT operates at three sites: University of Helsinki Kumpula campus, TKK main campus (Otaniemi), and Spektri building close to the Otaniemi main campus. The goal of HIIT is to conduct high quality research in information technology and related multi-disciplinary topics. The present research programmes are Algorithmic Data Analysis (ADA), Future Internet (FI), Network Society (NS) and Probabilistic Adaptive Systems (PAS). HIIT is an important bridge-builder in Aalto University's cooperation with the University of Helsinki.

The detailed data available to the Panel prior to the Site Visit Week concerned only the researchers working at the Spektri part of HIIT, because (i) the data relating to the University of Helsinki campus was not available for the Assessment Organisation and (ii) the researchers at the HIIT's main campus in Otaniemi are affiliated also with other TKK Units of Assessment and their achievements were listed in accordance with these other affiliations. However, HIIT's Self-Assessment Report covered the whole Unit and, accordingly, the Assessment Panel decided to evaluate the whole HIIT. The bibliometric analysis, in contrast, was based on the Spektri

data only and thus in this case the bibliometric analysis covers only a minor of HIIT's activities and, hence, it is not meaningfully comparable to the assessment report produced by the Panel.

### *Summary of Panel Assessment*

The Panel concludes that HIIT is very successful in its work: the quality of research at HIIT is outstanding, i.e. at the highest international level. The impact on the international scientific community, although at the very good international level, is nonetheless not quite as strong as one would expect on the basis of HIIT's outstanding research quality and the fact that HIIT is a pure research institute with no teaching obligations. The Unit collaborates with leading international experts, participates in multinational collaborations and networks, and the Unit's publications have an excellent citation rate, but HIIT still needs to work on its international brand recognition. The societal impact of HIIT's research is at the very good international level, thanks mainly to numerous start-up companies, several industry-HIIT collaboration projects and innovation activities of high societal visibility.

The main challenge for HIIT is to find a fruitful balance between its aspiration to become even more independent of its host universities on the one hand and the fact that the close ties to these universities facilitate the innovatively cross-disciplinary approach characteristic of HIIT on the other. The fact that HIIT is operating at three different locations appears to contribute negatively to the efforts for meeting this challenge.

### *Bibliometrics*

Since the collection of bibliometric data had to be limited to the Spektri part of HIIT (excluding thus both the HIIT main campus in Otaniemi and the University of Helsinki site in Kumpula), the Bibliometric Analysis fails to give a realistic and trustworthy picture of HIIT's research activities.

Although the Bibliometric Analysis covers only small part of HIIT and, accordingly, the number of analysed ISI publications is rather low (35) both absolutely and in comparison to e.g. the Scopus database, even the limited Bibliometric Analysis can be seen to generate some tentative conclusions for consideration. For example, the research efforts of HIIT appear to be characterised by willingness to be in the forefront of novel research: the vitality score (the recency of the cited literature) 1.28 is notably high, 6.9% of the publications belong to the top 5% of the field's most cited publications, and in general the articles are cited on average 24% more often than papers on average in the same journals. However, the field-normalised citation score 0.94 is, although close to the world average, somewhat low. This can perhaps be partly explained by the facts that the 35 HIIT articles analysed here (i) exclude the articles of HIIT's researchers affiliated with the University of Helsinki as well as the articles of TKK professors working at HIIT but with primary affiliations elsewhere and (ii) are published in journals with on average 16% lower citation impact than the global reference value in the Unit's field of research.

## Panel 5: Mechanical Engineering and Automation

### Units of Assessment

**Department of Energy Technology,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Department of Engineering Design and Production,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Department of Applied Mechanics,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Department of Automation and Systems Technology,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

### Overview

The mechanical engineering and automation departments covered by Panel 5 ought to emphasise strongly internationalisation of their research agenda, both in terms of seeking to attract more international experts to work at the units and in terms of strengthening the roles of basic research and international, high-impact dissemination of research results. Part of this process includes defining clear and ambitious research visions for the departments, and long-term strategic plans for realising the visions. Too many Units of Assessment neglect the role of world-class research in the task of educating professionals to meet the needs of industrial partners.

The planned introduction of a tenure-track system for academic staff is in the view of the Panel an important step in the process towards greater internationalisation and more research-driven culture at the Units of Assessment. The system should include clear incentives for improving the productivity, especially peer-reviewed journal publications, of Aalto University researchers.

Figures 5.5.3 and 5.5.4 appear to suggest that publications indexed in the ISI Web of Science are not extremely important for the disciplines covered by Panel 5. However, internationally in Mechanical Engineering 67% of all citations are to journal publications and ISI covers 76% of these citations.[19] This observation could be seen to support the Panel's assessment that the units covered by Panel 5 ought to highlight the importance of high-level research aiming at high-impact journal publications in their future strategies.

19 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

## Basic Data concerning the Units of Assessment

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

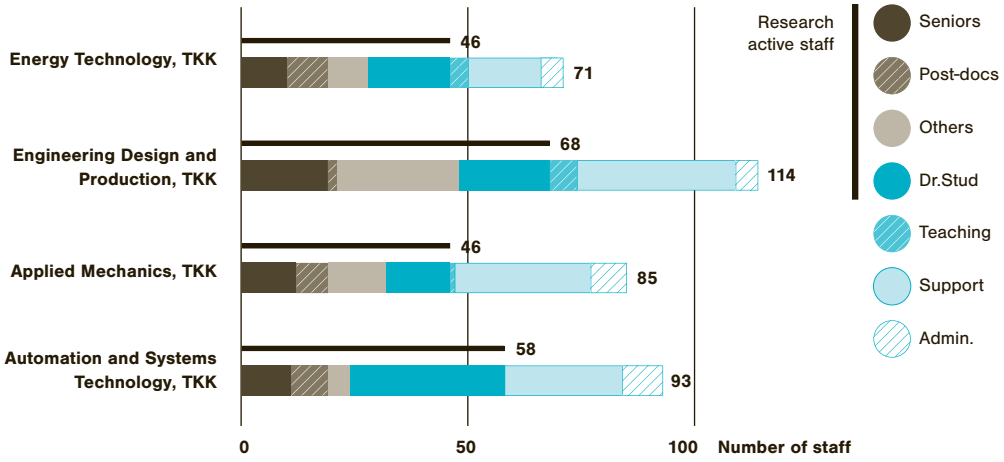


**Figure 5.5.1** Number of staff on the Aalto RAE census date of 1 October 2008.

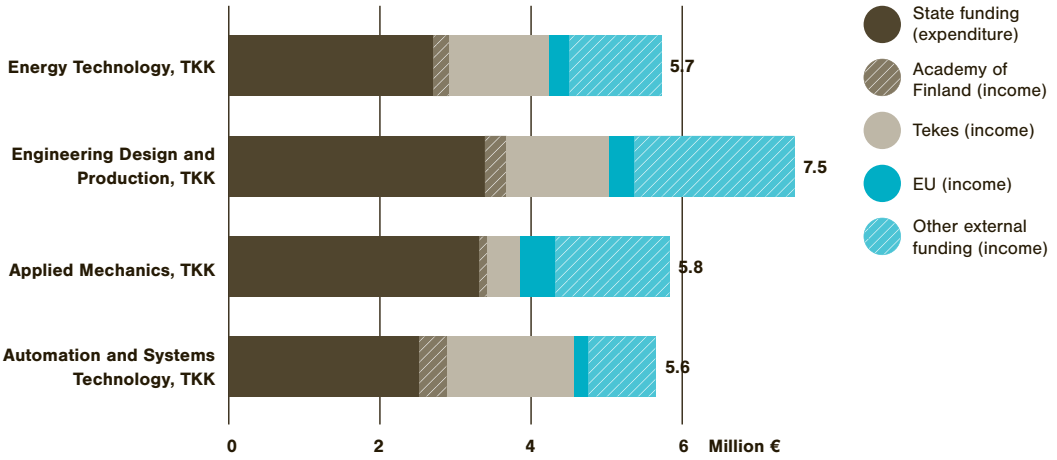


**Figure 5.5.2** Average annual funding during 2003–2008.

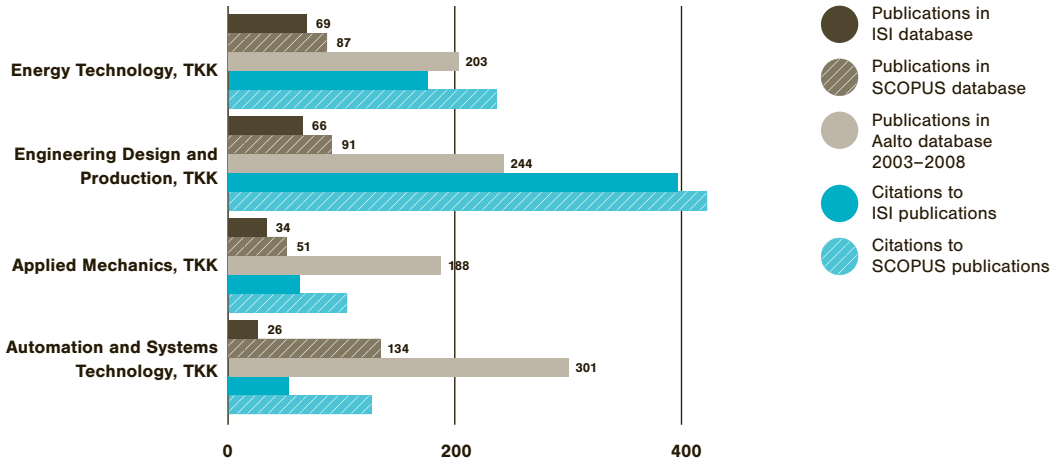


**Figure 5.5.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

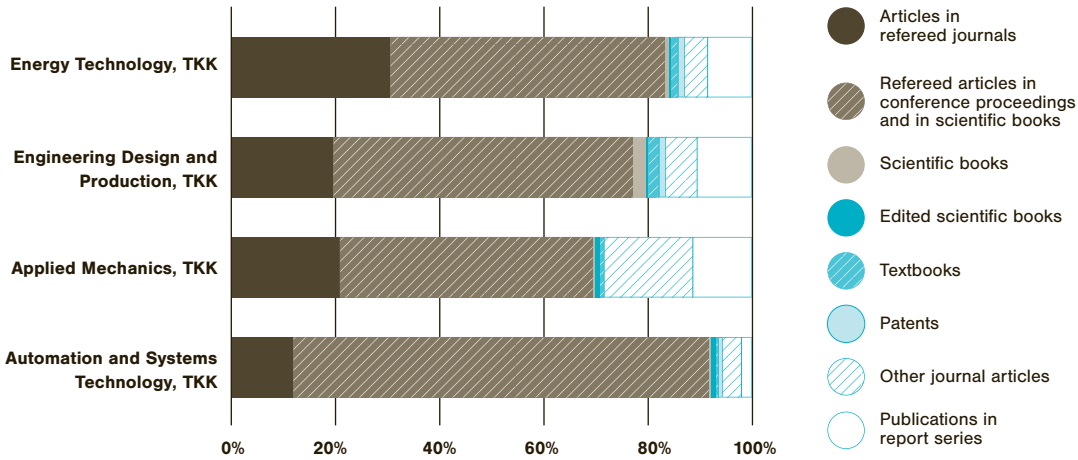


**Figure 5.5.4** Overall publication profiles 2003–2008.

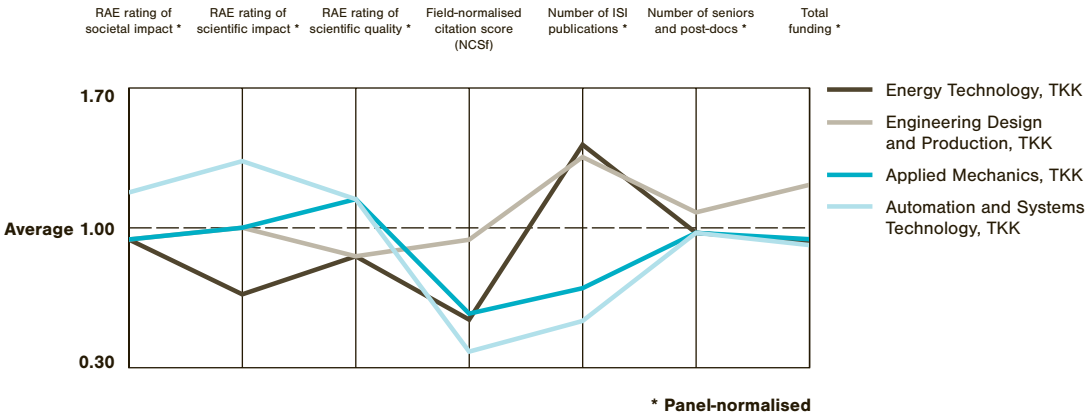


**Figure 5.5.5** Panel-normalised research indicators of the Units of Assessment in Panel 5 (1.0 is the average of Panel 5). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Energy Technology, TKK

### *Introduction*

The Department of Energy Technology comprises five research groups: (i) Applied Thermodynamics, (ii) Energy Engineering and Environmental Protection, (iii) Energy Economics and Industrial Energy Engineering, (iv) Heating, Ventilation and Air-Conditioning, and (v) Internal Combustion Engines Technology. These are the former laboratories of Department of Mechanical Engineering which were merged together on January 2008 to form the Department of Energy Technology. The main research fields of the Department are energy efficiency, advanced energy systems and energy related environmental aspects. Each of the five groups have own, more narrow research areas.

### *Summary of Panel Assessment*

The development from a collection of five distinct research groups into a single, coherent and collaborative department has begun at this Unit. The Unit is strongly recommended to continue this process by defining a shared long-term strategic vision for the Unit's research activities. Currently the research work of the Unit has an industrial focus, which tends to emphasise short-term project work rather than ambitious long-term planning. Accordingly, although the Unit's researchers have published in relatively good journals and the staff members have a good reputation, the Unit's research is nonetheless internationally neither very visible nor widely cited. The number of refereed publications is rather low in international comparison, as is the scientific impact of the Unit's research effort. The Unit has extensive and well-established collaboration with (predominantly Finnish) industry, and the societal impact of the Unit's research is already at the very good international level.

### *Bibliometrics*

The Bibliometric Analysis appears to support the Panel Assessment rather straightforwardly. The Unit's field-normalised citation score (NCSf) 0.54 falls significantly below the international average. The same can be said about the journal-normalised citation score (NCSj) of 0.60. However, the Unit has managed to get some publications into the top 5% of most cited publications in the field, which shows that the Unit has the potential for enhancing its performance in terms of international publications. Realising the potential will require that the Unit takes the Panel's advice to heart and defines long-term plans for increasing its research activities' impact on and the visibility within the international scientific community.

## Department of Engineering Design and Production, TKK

### *Introduction*

Department of Engineering Design and Production was established in 2008 on the basis of five laboratories. Research and education is focused on six areas which derive from the research fields of the former laboratories and their research groups. These fields are Vehicle Engineering, Integrated Product Development, Mechatronics, Engineering Materials, Production Engineering and Foundry Technology. The main aim of the department is to promote scientific and engineering knowledge in its field in Finland. The Unit's scientific research is designed to reach the Finnish science and technology policy goals and to fulfil the requirements of the national industry.

### *Summary of Panel Assessment*

The quality of research at this Unit is, on average, good, although there is considerable variation among groups and individual researchers. Taken as a whole, the Unit's publication rate in good-quality international journals is rather low, as is the annual number of awarded doctoral degrees. These are probably the main factors complicating the efforts to raise the Unit's impact on and visibility within the international scientific community. The Panel received the impression that many of the groups within the Unit do not have a culture of performing ambitious scientific research alongside the task of educating engineers for Finnish industry. On the other hand, the markedly close collaboration between the Unit and Finnish industry does lift the societal impact of research at the Unit to the very good international level.

### *Bibliometrics*

Although the focus of the Unit's activities is largely national, the Bibliometric Analysis indicates that also the efforts to raise the international visibility and impact of the Unit's research activities are starting to bear fruit. The field-normalised citation score NCSf of the Unit is at 0.94 already close to the international average. What is more, the journal-normalised citation score (NCSj) of 1.32 shows that the Unit's publications receive considerably more citations than other articles in the same journals. Also the vitality indicator (the recency of cited literature) is notably high at 1.26, and the Unit has even managed to get some papers into the top 5% of the field's most cited papers. However, the relatively low normalised journal citation score NJCS (0.73) suggests that the Unit tends to publish its research results in relatively low-impact outlets. Moreover, it should be noted that the major part of the Unit's international publications come from a discipline representing only a small part of the Unit's research field. Thus, sharpening the Unit's overall result dissemination strategy could be an obvious way of strengthening the Unit's international impact and visibility.

## Department of Applied Mechanics, TKK

### *Introduction*

The Department of Applied Mechanics was formed at the beginning of 2008 by merging five units of the previous Department of Mechanical Engineering. Currently the department consists of four research groups: (i) Fluid Mechanics, (ii) Solid Mechanics, (iii) Marine Technology, and (iv) Aeronautical Engineering. The Department is active in the following research areas: computational fluid dynamics (CFD) and its applications, finite element (FEM) and discrete element (DEM) methods, modelling and simulation of materials, ice mechanics, fatigue and fracture of materials and structures, ship hydrodynamics, ship motion dynamics and hydro-elasticity, safety of structures and transport systems, lightweight structures and their applications, and flight simulation.

### *Summary of Panel Assessment*

The Unit contains two groups that emphasise (also) basic research, the Fluid Mechanics and Solid Mechanics groups, and two groups that have an industrial and engineering application focus, the Marine Technology and Aeronautical Engineering groups. In general, the research at the Unit is at the very good international level. The experimental facilities for research in ice engineering form an internationally unique asset for the Unit, supported by other large experimental facilities for marine and aeronautical research. The Unit has also potential for innovative collaboration with other Aalto University Schools, e.g. within the Cruise and Ferry Experience project.

The scientific impact and visibility of the Unit's research is brought down by the low publication rate. Only the Marine Technology group can be considered to have international presence as a group, otherwise international visibility is on the shoulders of a few individual researchers. Strong collaboration with Finnish industry makes the societal impact of research to reach the very good international level. This, the excellent facilities as well as the positive attitude and capability for renewal at the Unit show that the Unit has very good potential to contribute importantly to the essential research activities in engineering at Aalto University. What is required for realising the potential is a long term vision and strategic plan for developing both the research activities as such and the international dissemination of research results.

### *Bibliometrics*

The Bibliometric Analysis gives support to the Panel Assessment. The number of papers is very low (34), and the Unit's field-normalised citation score (NCSf) 0.57 as well as the journal-normalised citation score (NCSj) 0.66 are significantly below the international average. The Unit ought to better utilise its excellent research infrastructure and good-quality research to achieve healthier international visibility and impact. A major way of accomplishing this is through emphasising the importance of disseminating research results in high-impact international outlets.

## Department of Automation and Systems Technology, TKK

### *Introduction*

The Department of Automation and Systems Technology was formed in January 2008 when the structural reorganisation of TKK was set in motion. The new Department is divided into four research groups: Automation Technology, Autonomous Systems, Control Engineering, and Information Technology in Automation. In addition, the Department includes the Academy of Finland Centre of Excellence Generic Intelligent Machines Research (GIM). The main research fields are intelligent mobile working machines, including machines in farming and forestry, field and service robots, automation design and management of industrial information, biotechnological systems, new energy technologies, building and home automation, wireless automation, micro- and nanorobotics, man-machine systems, process control, power electronics, and control of electrical motors.

### *Summary of Panel Assessment*

The quality of research at the Unit is at the very good international level and exhibits international excellence in terms of originality and significance. Internationalisation of research is already at a high level. The Unit's internationally leading role in many research areas means that its visibility within and impact on the international scientific community is very good: the senior members of research staff are internationally well connected and their work is influential and highly cited. However, the rate of journal publications (in addition to books and conference papers) could be higher. The societal impact of the Unit's research is at the highest, outstanding international level: The ties to industry, in particular, are well established and the Unit plays a leading role in technological innovation. Doctoral graduates of the Unit have found good positions both in the private and public sector.

The Panel considers the Unit to have the potential to generate breakthroughs in its field of research and to become a flagship of the Aalto University research. The main challenges the Unit faces in realising this potential include improving the journal publication rate, replacing the prestigious retiring professors with high-quality recruits, correcting the current gender imbalance of research staff at the Unit and increasing the international movement of the research staff.

### *Bibliometrics*

The Bibliometric Analysis of the research efforts of the Department of Automation and Systems Technology is seriously compromised by the feature pointed out by the Assessment Panel: the number of (ISI ) journal publications is very low both absolutely (26) and in relation to books and conference papers (Figures 5.5.3 and 5.5.4). Thus, the ISI Web of Science database (e.g. when compared to the Scopus database), and thereby the

Aalto University Bibliometric Analysis, cannot give a comprehensive picture of the Unit's research activities. Accordingly, where the Panel Assessment speaks rather highly of the Unit's research achievements, the field-normalised citation score (NCSf) 0.38 of the Unit's ISI publications gives a picture of a unit working significantly below the international average of the field. This could be partly explained by the fact that although the Unit publishes in journals with good citation impact (11% above the world average), the Unit's publications receive on average 59% less citations than other articles in the same journals.

# Panel 6: Civil Engineering and Urban and Regional Studies

## Units of Assessment

**Department of Surveying,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Department of Structural Engineering and Building Technology,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Department of Civil and Environmental Engineering,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**The Lahti Center,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Centre for Urban and Regional Studies (YTK),**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

## Overview

Due to the imminent wave of retirements and the recent organisational restructuring, the Units of Assessment covered by Panel 6: Civil Engineering and Urban and Regional Studies are in the process of transition. This creates a major challenge for the Units of Assessment which, in their current state of development, are not yet coherent units in the first place but closer to ad hoc collections of groups with a lot of internal variability. The Panel notes that the units show very realistic understanding of their internal strengths and weaknesses as well as the external opportunities and threats they are facing. This awareness will surely help in turning the challenges into opportunities. The units ought to define long-term strategic visions and plans for establishing the units as coherent and internationally well-known research units.

An important aspect of raising the research profile of the Units of Assessment could be achieved by highlighting the strategic importance of cooperation with other TKK units and disciplines as well as with the HSE and TaiK units. For example, the content of these disciplines have clear links to architecture, but such connections have not yet been exploited.

Internationalisation has remained somewhat one-sided at all the Units of Assessment evaluated by Panel 6. First of all, the researchers have impressive international networks, and they are active in international societies. However, the number of international faculty and international

doctoral students is strikingly low. Introducing a tenure-track system with international recruitment policy is seen by the Panel as the single most important factor in successful internationalisation.

Finally, the Panel notes that an aspect hampering the internationalisation and impact on the international scientific community of the Units of Assessment is the relatively low number of international journal publications (cf. Figures 5.6.3 and 5.6.4). This can be seen e.g. in the fact that the Aalto University Bibliometric Analysis, which is based on publications in the ISI Web of Science database, is not applicable to 3 of the 5 units, because the number of ISI publications is too low in these three units. Accordingly, although Figure 5.6.5 includes the field-normalised citation score NCSf for all units, it is really applicable only to the Department of Structural Engineering and Building Technology and the Department of Civil and Environmental Engineering. However, internationally in the field of Civil Engineering 51% of total references are to journal publications, and ISI Web of Science covers 71% of these.[20] Thus, the units might wish to reconsider the role of international, peer-reviewed journal publications in their research and internationalisation strategies.

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

20 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

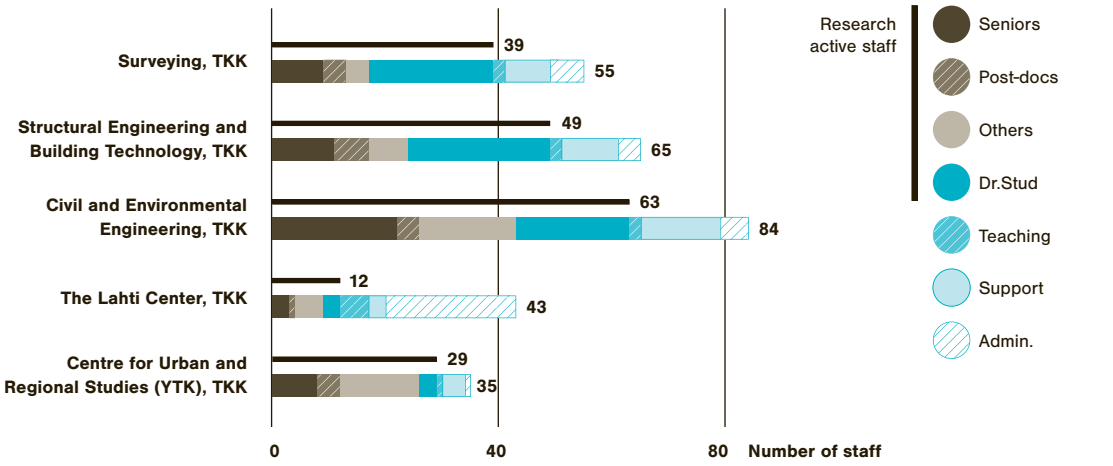


**Figure 5.6.1** Number of staff on the Aalto RAE census date of 1 October 2008.

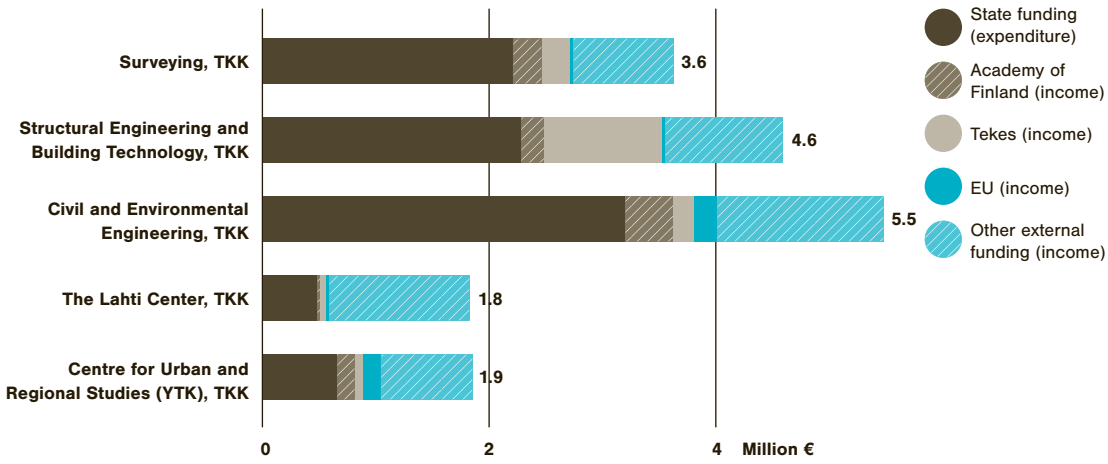


**Figure 5.6.2** Average annual funding during 2003–2008.

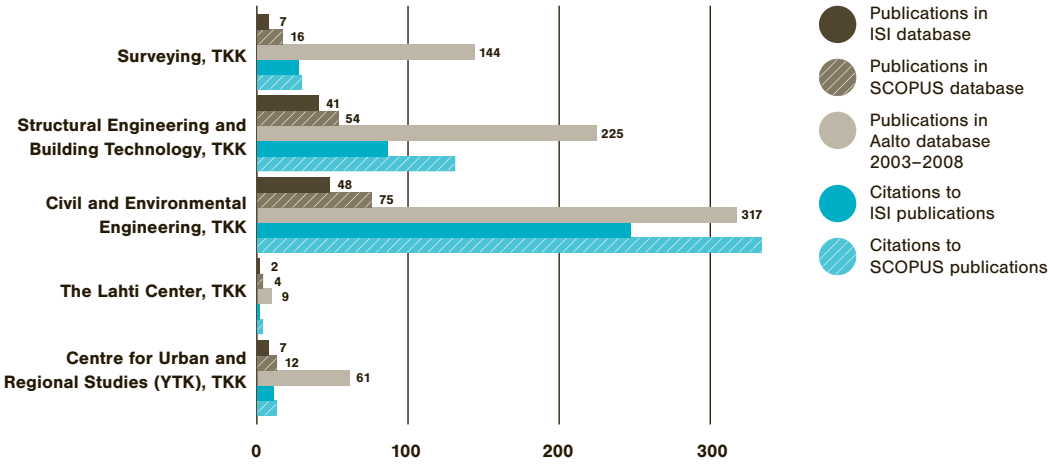


**Figure 5.6.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

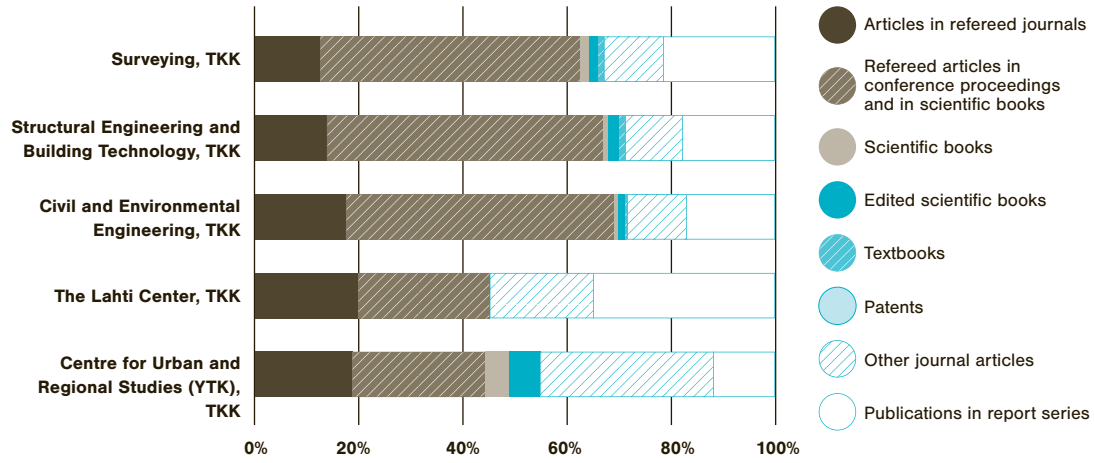


**Figure 5.6.4** Overall publication profiles 2003–2008.

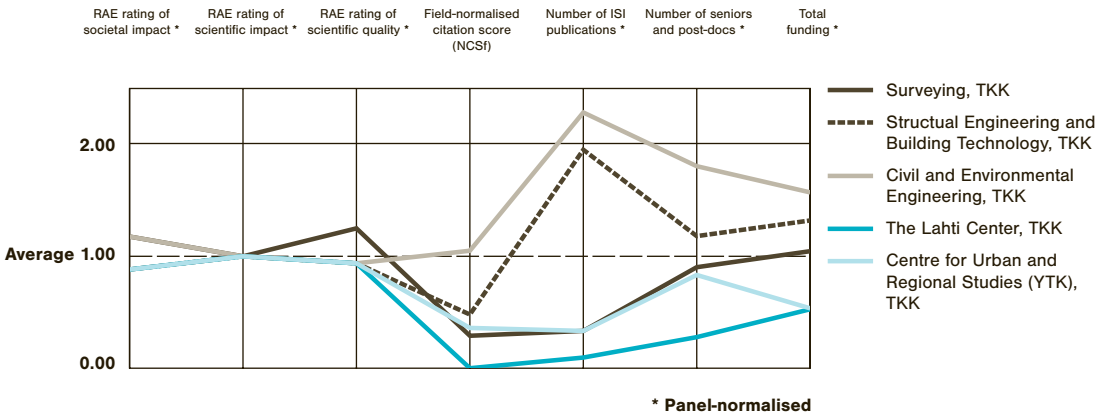


**Figure 5.6.5** Panel-normalised research indicators of the Units of Assessment in Panel 6 (1.0 is the average of the Panel 6). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Surveying, TKK

### *Introduction*

The Department of Surveying has existed from the founding of TKK in 1908. Today the main research fields of the Unit are real estate management and business, real estate economics and valuation, land management, geodesy, positioning and navigation, photogrammetry, remote sensing, cartography, and geoinformatics.

### *Summary of Panel Assessment*

The combination of the two main research areas of the Unit, Geomatics and Real Estate Economics, is unique in the world. There is a widespread interest at universities across the world in establishing similar structures and, thus, the Unit could serve as an international role model in this respect. Normally this combination is motivated by teaching requirements rather than research synergies, and thus its contribution to research is unclear. However, a strategy for cooperation and mutual support between these two fields also with regard to research is clearly visible in the Unit's research activities.

While the quality of research at the Unit is, on average, at the very good international level, the Geomatics part of the Unit has some gaps. To be internationally comparable and competitive, the Unit would require additional professorships to the central areas of geomatics. Even with this deficiency in the number of professorships, the Panel considers the Unit to be the best group in its field in the Nordic countries.

The scientific impact of the Unit, currently at the good international level, is nonetheless lower than the quality of research would have one to expect. Except for the admirable service for international learned societies, the Unit appears to have somewhat neglected the exchange, interaction and dissemination of research results on international level. The societal impact of the Unit's research, on the other hand, is at the very good international level, as is the research environment at the Unit and the Unit's future potential.

The Panel recommends that the Unit defines an explicit research strategy aimed at realising the Unit's excellent research potential. The main challenges to be addressed in such a long-term strategy include internationalisation (both attracting foreign doctoral students and researchers into the Unit and supporting research visits of the staff to abroad), explicating the roles of the two research groups and their research cooperation, adding new professorships to cover the current gaps in the geomatics part of the Unit and encouraging publication in high-level international journals.

### *Bibliometrics*

The Panel notes that the Department of Surveying may have somewhat neglected the international dissemination of its research results, and indeed

the low number of ISI publications (7) makes the Bibliometric Analysis inapplicable to the Unit. The Unit ought to follow the Panel's advice and seriously emphasise high-level international journal publications in its future research activities.

## Department of Structural Engineering and Building Technology, TKK

### *Introduction*

In the beginning of 2008 the old Department of Civil and Environmental Engineering was divided into two separate departments, one of which was named as the Department of Structural Engineering and Building Technology. The research in the Department covers principally the main fields of the structural branch of civil engineering: structural analysis, structural engineering, building economics and construction management, building materials technology, and building physics.

### *Summary of Panel Assessment*

The Unit is currently ongoing a transition from a teaching unit to combining scientific research and teaching. Together with impending structural changes, such as a number of key professors retiring, this creates some confusion concerning the Unit's identity and main mission, and the Unit would greatly benefit from a comprehensive and clearly articulated strategic development plan and a shared research vision. Although the number of journal publications remains presently somewhat on the low side, the quality and impact (both scientific and societal) of the Unit's research are already on average at the good international level, and this should make the transition towards an international research unit less drastic.

The reformation process that has already been set in motion at the Unit may, if managed carefully, make the change towards increased internationality and research-driven culture (including supporting research and doctoral education rather than non-doctoral technical staff) more readily possible. Thus, with an extensive strategic plan the Unit may well turn the major challenges it is facing into an inspirational opportunity to transform the department into an internationally recognised research unit.

### *Bibliometrics*

The Bibliometric Analysis supports the Panel Assessment. The process of turning towards a more research-driven culture and orientation towards the international research community has only begun at the Department of Structural Engineering. Currently the Unit's field-normalised citation score (NCSf) 0.48 is significantly below the international average, as is the case also with the journal-normalised citation score (NCSj), presently at 0.54.

## Department of Civil and Environmental Engineering, TKK

### *Introduction*

The former Department of Civil and Environmental Engineering was divided into two new Departments in January 2008. The more traditional Civil Engineering disciplines such as water, highway and geotechnical engineering retained the name of the former department. Eight of the former laboratories form the research and teaching units of the Department. The research focus areas are water engineering (incl. water resources, water supply and waste water engineering), transportation engineering (incl. traffic, transportation and highway engineering), geotechnical engineering (incl. soil mechanics, foundation engineering, rock engineering, engineering geology and applied geophysics), and environmental engineering (incl. waste and material flow management and geoinformatics).

### *Summary of Panel Assessment*

The Panel assessed the environmental engineering section of the Unit as part of the Lahti Center.

As with many other units, also in the case of this Unit internationalisation tends to be somewhat one-sided in the sense that the researchers are actively engaged in international (especially Nordic and European) networks, but the proportion of international staff and students at the Unit remains rather low. The Unit has formulated a mission and vision statement to support the ongoing transition from emphasising teaching towards a more research-driven culture. The Unit is also in the process of preparing a strategic plan addressing the issues relating to the replacement of many key professors that are retiring in the coming years. This willingness to take the initiative in redefining the Unit's approach to international research puts the Unit in a good position to raise its currently good research quality and scientific impact closer to the world's leading research units in the field, especially when the Panel considers the Unit's younger professors to publish already at the very good international level.

The Unit has also realised that their high-quality research results have not always found their way into international journals. This realisation suggests that one can expect improvement also in this respect in the foreseeable future. The applied focus of the Unit's research activities has already lifted the societal impact of the Unit's research onto the very good international level. What is required next is a clear strategic commitment to long-term scientific research with an ambitious publication strategy.

### *Bibliometrics*

The Bibliometric Analysis appears to confirm the view of the Panel that the transition towards a research-driven departmental culture is already underway at the Department of Civil and Environmental Engineering. The field-normalised citation score NCSf of the Unit is at 1.05 very close to the international average, and the Unit has managed to get some of its

publications into the top 5% of the field's most cited articles. Also the very high vitality score (the recency of cited literature) 1.39 gives evidence of a strong commitment to be at the international forefront of research.

## The Lahti Center, TKK

### *Introduction*

The TKK Lahti Center was founded in 1986. In 2004 the research field of the TKK Lahti Center was defined as Environmental Technology. Since the beginning of 2008, the Center has been a separate institute administered through the Faculty of Engineering and Architecture. The TKK Lahti Center is situated on the Lahti Environmental Campus. The Center cooperates with various TKK departments carrying out environmental research on the Otaniemi campus, and coordinates the collaborative work group on environmental research at TKK. The Center is also a partner in the Lahti University Consortium. The organisation of the Center is built around three areas: research, education leading to a degree and continuing education and development services for business partners.

### *Summary of Panel Assessment*

Although the Lahti Center confirmed a new research strategy in 2008, the Panel feels that there is still urgent need for strategic planning at the Unit on the basis of the overall research strategy of Aalto University and the Unit's position within the multidisciplinary Lahti University Consortium. This would help the Lahti Center to realise better its full potential in multidisciplinary and industry-academia related activities.

Currently the number of research active staff at the Unit is still very small, but nonetheless the scientific quality and impact of the Unit's research can be considered to be good. The number of publications is still very low and, given the small size of the Unit, the Lahti Center might want to rethink how the Unit's main activities relate to the work at other TKK units in order to increase productivity through cooperation. The societal impact of the Unit's research is good, although taking place mainly at the regional level. The thematic research areas of the Lahti Center, focusing on environmental technology, are important and timely both academically and for society at large. This strengthens the future potential of the Unit, although it also means that national and international competition in the field is fierce. For a small Unit, active networking at the Aalto, national and international level will be the key if the Unit wishes to make important local and international contributions. This requires that the research focus is shifted from opportunity-driven research (determined by the funding opportunities and regional and industry expectations) to a more strategy-driven model.

### *Bibliometrics*

The Lahti Center has thus far not produced sufficiently many ISI publications (2) for the Bibliometric Analysis to be applicable to the Unit.

## Centre for Urban and Regional Studies (YTK), TKK

### *Introduction*

The Centre for Urban and Regional Studies YTK was founded in 1968 as a national multidisciplinary centre for further education in urban and regional planning and urban studies. Over the years the Centre has developed an interdisciplinary research profile and functions related to post-graduate training. As a part of the research strategy, YTK has specified six focus areas: 1) sustainable urban structure, 2) urban space and housing, 3) place-experience and participatory planning methods, 4) European metropolises and regions), 5) partnerships and conflicts, and 6) evaluation research.

### *Summary of Panel Assessment*

The Panel notes several positive trends within YTK, such as growing internationalisation, transition from teaching to a combination of research and teaching, the increasing amount of external research funding, the appointment of the new director and the willingness to enhance research further. Currently the quality of YTK's research is at the good international level. To still improve the quality the Panel suggests that the Unit sharpens its publication policy and supports longer-term research goals, including targeting funding from more academic research funders and increasing the number of doctoral students. The Panel considers the scientific impact of the Unit's research to be strong: the Unit and its researchers are actively involved in Nordic and European networks and well-known to their colleagues from other parts of Europe even if this is not always reflected in the citation rate of the Unit's publications. The societal impact of the Unit's research is good.

In summary, the Panel considers the Unit to be well-placed to become an international centre of excellence in its field. Fulfilling the Unit's excellent potential requires clearer long term vision and strategic planning, and the necessary funds for realising such ambitions. Otherwise the Unit may turn into a contract-research centre run on project money, which would make it virtually impossible to be at the scientific forefront.

### *Bibliometrics*

The low number of ISI publications (7) makes the Bibliometric Analysis inapplicable to the Centre for Urban and Regional Studies. The Unit ought to follow the Panel's advice and seriously emphasise high-level international journal publications in its future research activities.

## Panel 7: Business Technology, Economics and Finance

### Units of Assessment

**Department of Accounting and Finance,**
Helsinki School of Economics (HSE)

**Department of Business Technology,**
Helsinki School of Economics (HSE)

**Department of Economics,**
Helsinki School of Economics (HSE)

### Overview

The Units of Assessment covered by Panel 7 represent the quantitative dimension of HSE's business research. The general conclusion of the Assessment Panel is that the transition from a predominantly teaching institution into a research-driven university, which is a challenge faced presently by the business schools across the world, has been successful at HSE.

It should be noted that although Figure 5.7.5 includes the field-normalised citation score NCSf, in the case of Panel 7 this indicator is fully applicable only to the Department of Business Technology. At the Department of Accounting and Finance the number of ISI publications is too low for the indicator to yield meaningful results. In the case of the Department of Economics the number of ISI articles warrants the use of the indicator, but the number is nonetheless so low that the score may be vulnerable to distortions. Moreover, although the normalised indicators utilised in the Aalto University Bibliometric Analysis take the age of the publications into account, it is generally allowed that in the disciplines covered by Panel 7 the citation window of eight years (and even shorter for more recent publications) is too brief to reveal unambiguously which publications turn out to be the truly significant contributions to the field in question.

The Units of Assessment ought to consider whether they should seek to further strengthen the role of international, peer-reviewed publications in their research strategy. Internationally, in the field of Finance, for example, 66% of all citations are to journal publications, and ISI covers 83% of these. In Economics, the same figures are 56% and 83%, respectively.[21]

### Basic Data concerning the Units of Assessment

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

21 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

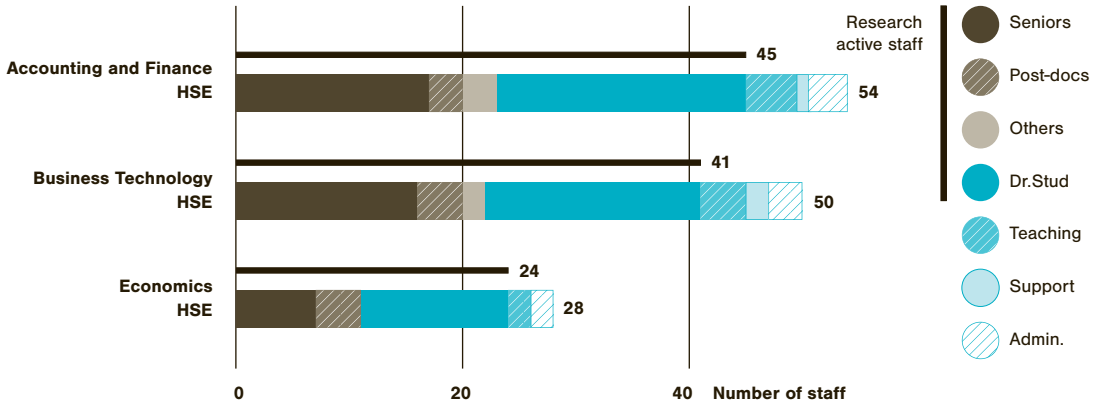


**Figure 5.7.1** Number of staff on the Aalto RAE census date of 1 October 2008.

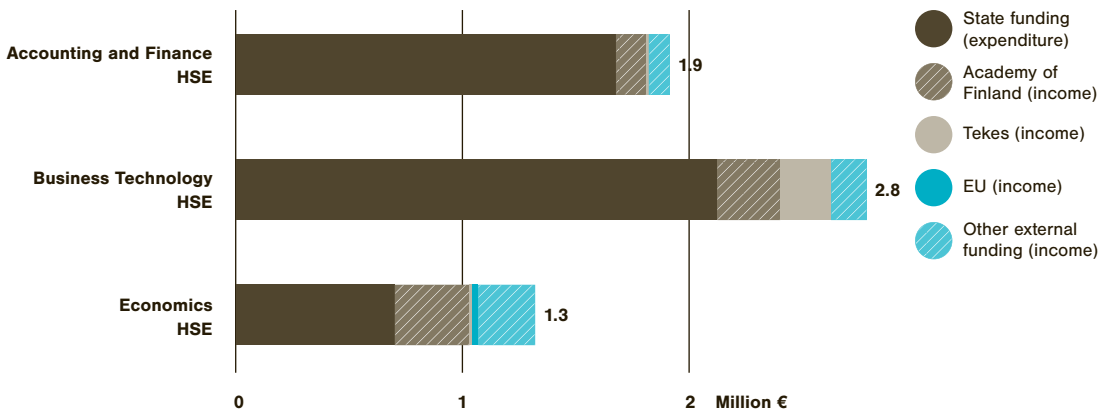


**Figure 5.7.2** Average annual funding during 2003–2008.

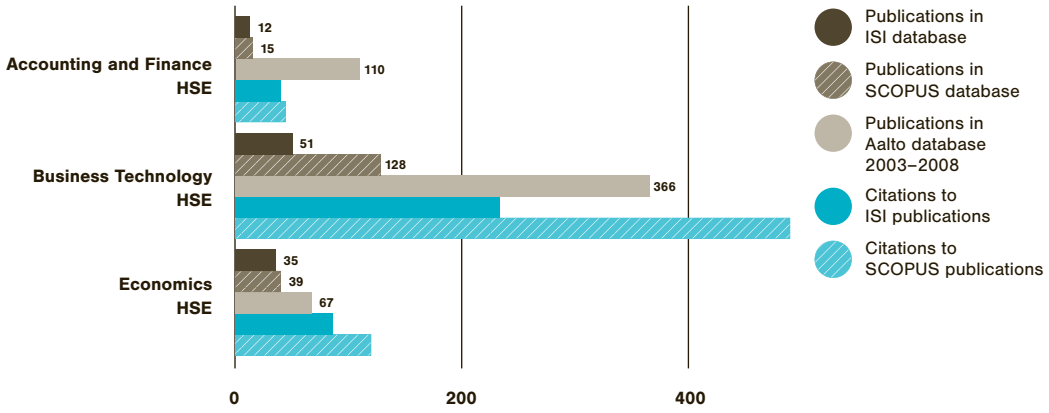


**Figure 5.7.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

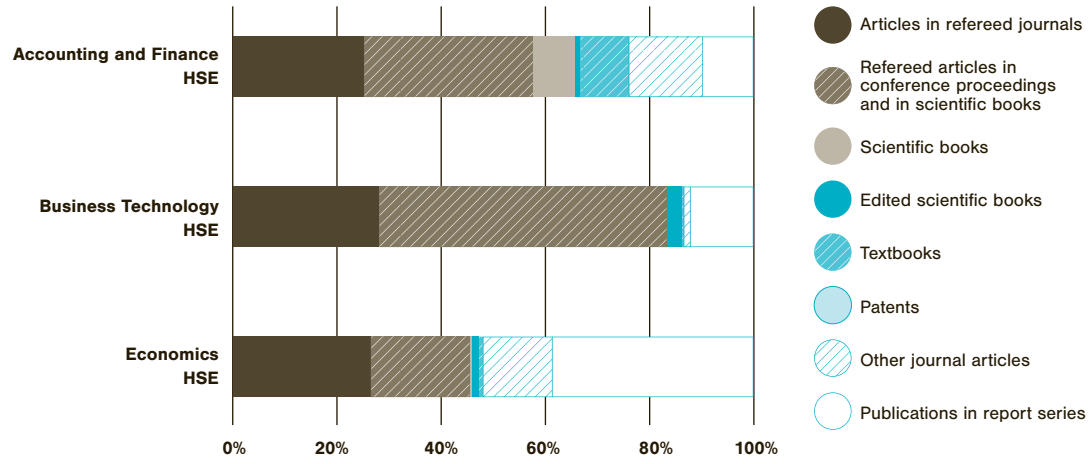


**Figure 5.7.4** Overall publication profiles 2003–2008.

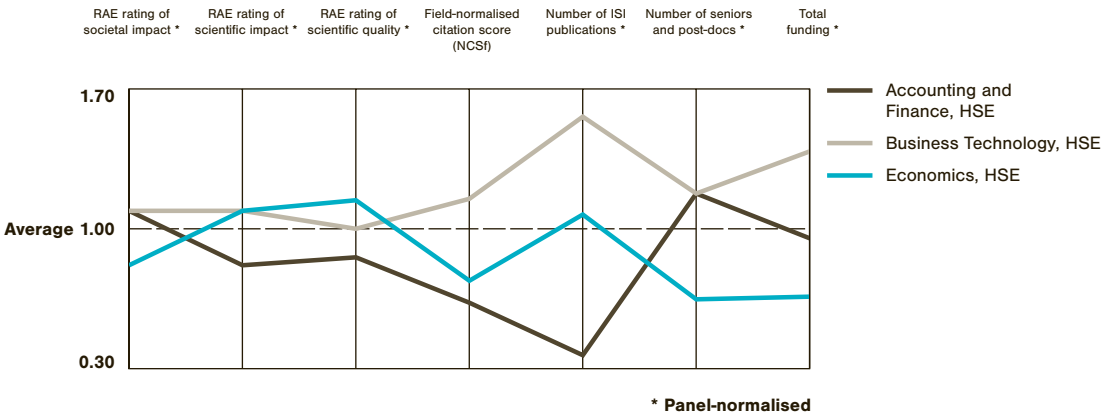


**Figure 5.7.5** Panel-normalised research indicators of the Units of Assessment in Panel 7 (1.0 is the average of Panel 7). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Accounting and Finance, HSE

### *Introduction*

The Department of Accounting and Finance comprises three academic disciplines; Accounting, Finance and Business Law. Grouping business law together with accounting and finance serves well the department's teaching needs, for the discipline plays a major role in the education of auditors and in the regulation of Finnish capital markets. The main research areas are asset pricing, behavioural finance and corporate finance (finance area), financial accounting and management accounting (accounting area). Research at these areas aims at high-quality publications in high-impact refereed international journals. The business law area studies financial markets, taxation and company law, contract and marketing law, competition law and intellectual property rights mainly in national context.

### *Summary of Panel Assessment*

The three research areas of the department, Accounting, Finance and Business Law, have distinct research profiles. The Finance area has enjoyed considerable recent success in publishing in top international journals. The successful emphasis on behavioural finance connects the work at the Unit with topical trends in the field and the access to unique data allows the finance area to make new contributions to the domain.

The quality of research in the Finance area can be considered to be at the very good international level with a good world-wide visibility. The Accounting area publishes regularly in journals widely recognised in Europe but with less visibility in North America. The quality of research in the Accounting area is at the good international level. The Business Law area is mainly focused on national issues with a very limited international visibility. The Panel assesses the quality of research in the Business Law area to be at the fair international level. The area is of considerable importance in supporting other HSE departments.

The societal impact of the Unit's research, taken as a whole, is at the very good international level. The research environment at the Unit is very good, although hampered by the lack of access to international databases. Given the wide scope of research areas covered by the Unit and the teaching load required from the Unit, the Unit is also somewhat understaffed. However, in particular the Finance area has the potential for significant international recognition if the recent trend in research productivity continues and the well-developed international recruiting plan is realised.

### *Bibliometrics*

The low number of ISI publications (12) makes the Bibliometric Analysis largely inapplicable to the Department of Accounting and Finance. However, the analysis of those few publications shows that the Unit is able to target high-impact outlets (53% above the global reference value for the field). Moreover, the high vitality score (the recency of cited literature) 1.17 may support the

Panel Assessment that the research emphasis on behavioural finance connects the Unit well with very topical issues in the international debate.

**Department of Business Technology, HSE**

*Introduction*

The Department of Business Technology comprises the areas of Logistics, Information Systems, Management Science and Quantitative Methods. The integrating theme of the Unit is the study of the opportunities that the developments of modern technology open for business organisations. The researchers in logistics have turned the research focus largely on service development. The research in information systems focuses on ICT applications in service design and management, while the aim of management science is to develop and apply the theory and behaviourally realistic computer-based tools for improving decision and planning processes in business organisations. Research in the quantitative methods area focuses on management and planning problems in a computer-assisted environment, serving the Unit's other areas as well as other quantitative disciplines across The Helsinki School of Economics.

*Summary of Panel Assessment*

The Unit is a characteristically research-oriented department with an international focus and strong international visibility across the group. There is good synergy and multidisciplinary cooperation between the four areas of the Unit as well as with other HSE and TKK units. The quality of research at the Unit is strong, on average between the good and very good international levels. The scientific impact of the Unit's research is at the very good international level. The citation rate of the publications is strong, and the senior members are well-known to their academic colleagues in their respective research areas internationally. In addition to theoretical work, the Unit is very active also in applied research reflecting real life problems. Accordingly, the societal impact of the Unit's research is also at the very good international level.

The Unit is highly motivated and committed to top-quality international research. The Unit has a strong international reputation and visibility, which gives the Unit very good potential to rise to an internationally leading position in its field. The main future challenges of the Unit relate to the task of replacing the retiring professors with equally prominent researchers and to the need to update the computational resources of the Unit that are currently lacking behind.

*Bibliometrics*

Researchers at the Department of Business Technology publish in relatively high-impact journals (on average 19% above the field's global reference value), and the Unit's field-normalised citation score 1.15 is above the international average. The Unit has managed to get some publications to the top 5% of the field's most cited publications. In light of the Bibliometric Analysis, the

Unit's research performance has reached a firm international level. It should also be noted that the ISI Web of Science, on which the analysis is based, is somewhat less representative (e.g. in comparison to Scopus) in the Unit's field of research than in other areas of business studies.

## Department of Economics, HSE

### *Introduction*

The Department of Economics has grown in less than 20 years from a one-professor teaching unit to the current research-focused unit of four full professors and one fixed-term professor. All of the full professors have doctoral degrees awarded by leading US and UK universities, and among the other senior and post-doctoral staff HSE graduates are in the minority. In terms of internationalising the research environment, this situation is exceptional among the Aalto University units. The Unit aims at excellence in research, the main research focus being on microeconomics (broadly understood). A major asset for the Unit in its current stage of development is the cooperation within the larger research community at the Helsinki Centre for Economic Research (HECER), which hosts the economics departments of HSE, Hanken School of Economics and the University of Helsinki. Currently HECER comprises altogether 19 professors of economics (some of them fixed-term). Cooperation at HECER makes it possible to run a number of high-quality internal workshops and seminars in several sub-fields of economics.

### *Summary of Panel Assessment*

Compared to the economics departments of leading universities in the world, the Unit is still very small. Thus, the joint operation of the departments of economics of HSE, University of Helsinki and Hanken School of Economics under one roof at HECER provides clear and crucial synergy and scale advantages for the Unit. Currently, given its size, the Unit can be considered to be a high-performing unit with a vibrant research environment at all levels. Moreover, the Unit has a clear forward trajectory. The quality of research at the Unit is at the very good international level. The Unit has an excellent publication record in the hard-to-reach top journals. The Unit focuses on quality and has a clear emphasis on targeting top outlets. Accordingly, the Unit's impact on the international scientific community is at the very good international level, while the societal impact is at the good international level.

The unique structure for cooperation and scale provided by HECER as well as the Unit's good comprehension of what is required for international excellence and visibility entail that the Unit has very good potential for developing into a truly world-class research unit. The main obstacles for realising this potential are the small size of the Unit and the related fact that the number of students at the Unit is growing much faster than the number of staff.

*Bibliometrics*

The citation impact of the publication outlets of the Department of Economics is on average 24% higher than the global reference value in the field, which indicates that the Unit's goal of targeting high-impact journals is bearing fruit. However, the journal and field-normalised citations scores (both 0.74) remain, although close to the world average, somewhat on the low side.

# Panel 8:
# Marketing, Management and Applied Business Research

## Units of Assessment

**Department of Industrial Engineering and Management,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Business, Innovation and Technology Research Centre (BIT),**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)

**Department of Languages and Communication,**
Helsinki School of Economics (HSE)

**Department of Marketing and Management,**
Helsinki School of Economics (HSE)

**Center for Knowledge and Innovation Research (CKIR),**
Helsinki School of Economics (HSE)

**Center for Markets in Transition (CEMAT),**
Helsinki School of Economics (HSE)

## Overview

Panel 8 includes the Units of Assessment at HSE and TKK that focus on applied business research and/or the research profile of which is characterised by a somewhat less quantitative approach to business research than adopted by the units covered by Panel 7. Nonetheless, the Units of Assessment in Panel 8 are rather heterogeneous, consisting of three academic departments and three research institutes.

The Assessment Panel notes that there are several problems in assessing the departments and institutions in the same assessment and by using the same criteria. For example, it is largely the same individuals that function in different roles both in TKK's Department of Industrial Engineering and Management (DIEM) and the BIT Research Centre. However, since their primary affiliation is with DIEM, their research achievements are in the assessment assigned to it, and the individuals in question are listed as belonging to the research active staff of the Department.

Accordingly, when Figure 5.8.2 shows that a notable share of DIEM's funding is acquired "via institutes or BIT", the funds in question are acquired by DIEM's researchers but managed at BIT, and thus the same funds are also shown in BIT's statistics in accordance with their source. For example, many of the Tekes projects of the professors at DIEM are managed at BIT, and thus the funding of such projects is shown in Figure 5.8.3 both as BIT's

Tekes funding and as DIEM's "via institutes or BIT" funding. However, the actual research work is carried out at BIT. The Panel has made an effort to assess the factual research performance of BIT, also taking into account the focus on knowledge transfer that is characteristic of BIT's activities.

On HSE's side there are similar issues: The HSE strategy sees the research institutes CKIR and CEMAT as forming, together with the four research priority areas, the horizontal dimension in HSE's matrix model of organising research activities. The vertical dimension follows the academic departments. The idea of the dimensions is that the basic scientific research is carried out predominantly at the departments, while the research institutes and priority areas serve to integrate existing research into multidisciplinary programmes and to connect the research better with the needs of external partners. Something comparable could perhaps be said about the factual relationship between TKK's DIEM and BIT Research Centre. However, the Panel notes that the centres show a willingness to challenge this division of research labour and to become more like departments in having their own doctoral students and research fields. The role of the centres vis-à-vis academic departments is something the Aalto University may wish to reconsider in the future.

In respect to organisational issues the Panel notes that the activities of HSE's Department of Business Technology (Panel 7) are such that the obvious cooperative possibilities with TKK's DIEM, and indeed with several other TKK units, should be carefully investigated and exploited. The already existing collaborative synergies between HSE's Department of Marketing and Management and DIEM should also be further developed.

Finally, it should be noted that Figure 5.8.5 includes also the field-normalised citation score NCSf. However, because of the insufficient number of ISI articles this indicator in actual fact is not applicable to HSE's Department of Languages and Communication and CEMAT at all. Also at CKIR and BIT the number of ISI publications is so low that the indicator remains vulnerable to distortions. Even the units with a higher number of ISI publications might wish to consider whether in the future they should emphasise even more research aiming at international, peer-reviewed journal publication even more in their research activities (cf. Figures 5.8.3 and 5.8.4). Internationally, in the field of Business Research 64% of all citations are to journal publications, and ISI covers 78% of these. In Management the corresponding numbers are 59% and 76%, respectively.[22]

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

22 Henk F. Moed, *Citation Analysis in Research Evaluation*, Springer, Dordrecht, 2005, p. 129.

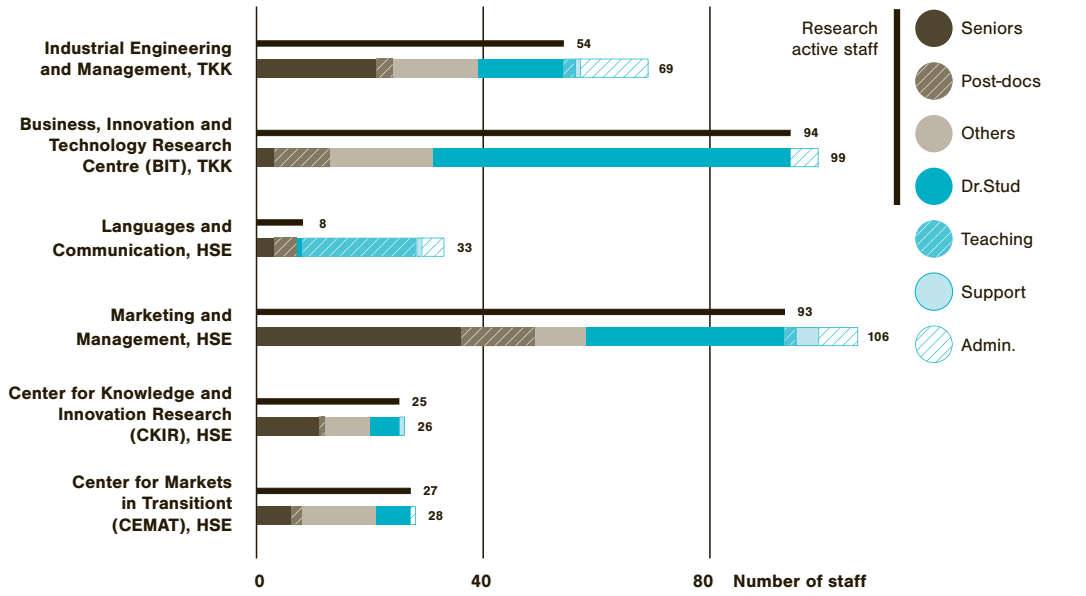


**Figure 5.8.1** Number of staff on the Aalto RAE census date of 1 October 2008.

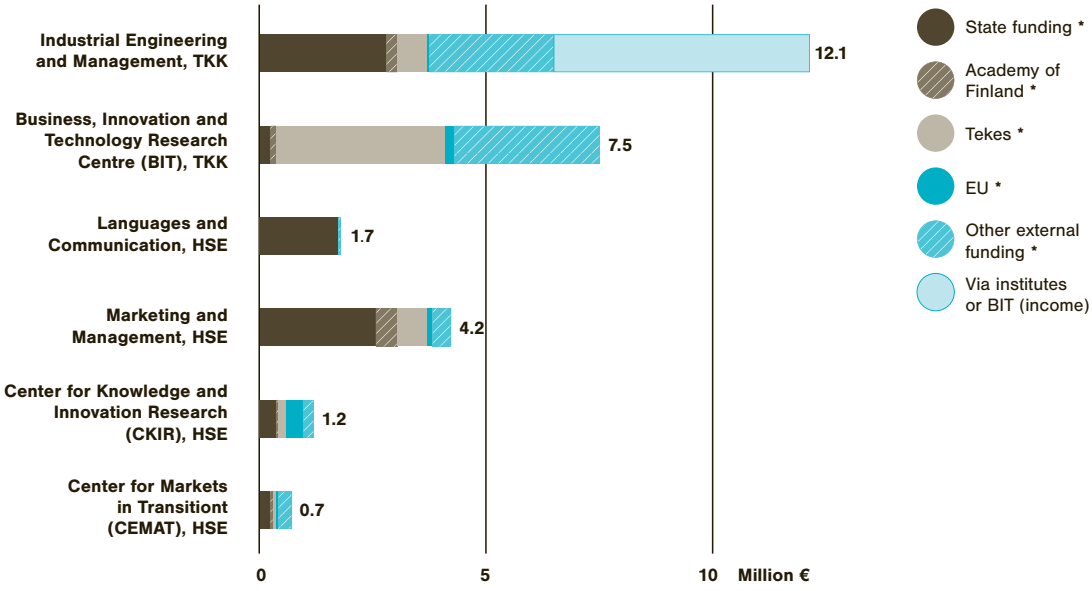


**Figure 5.8.2** Average annual funding during 2003–2008. * HSE (expenditure), TKK (income)

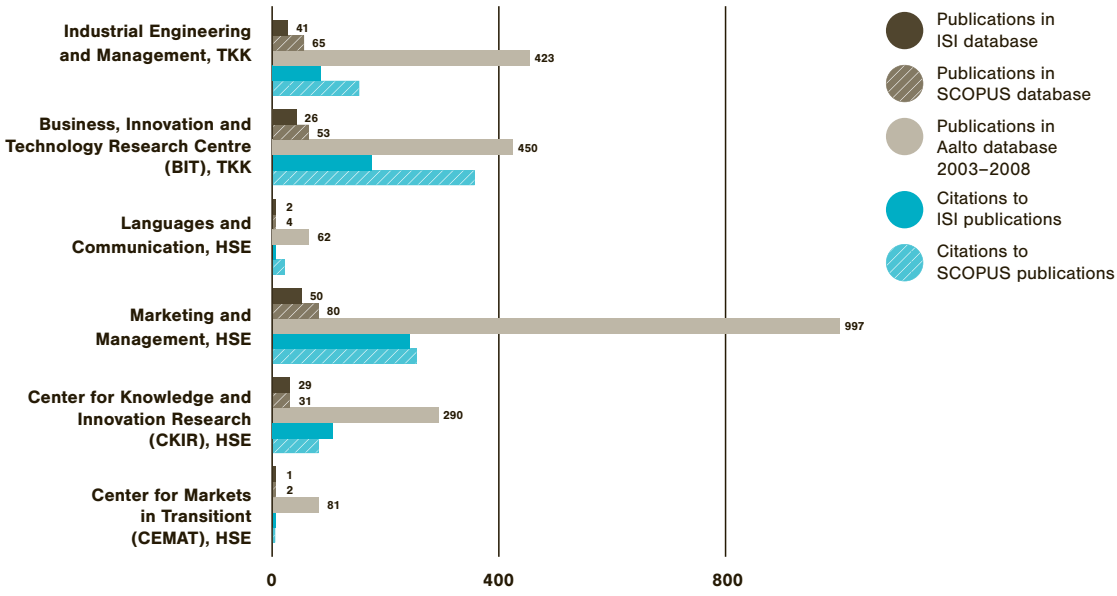


**Figure 5.8.3** Number of refereed international articles/conference papers in 2003–2007 and number of citations in 2003–2008.

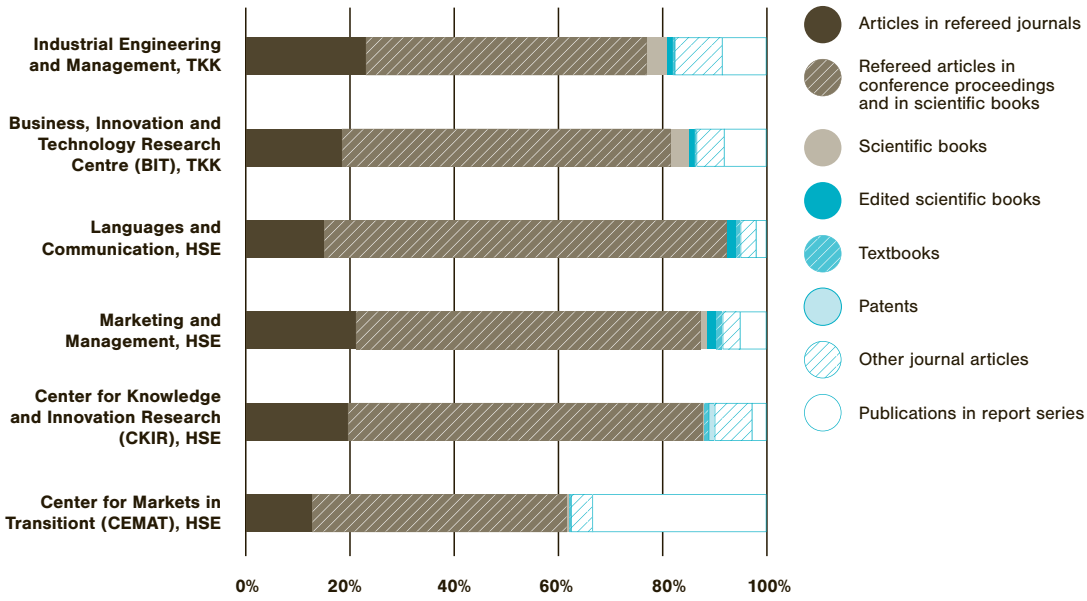


**Figure 5.8.4** Overall publication profiles 2003–2008.

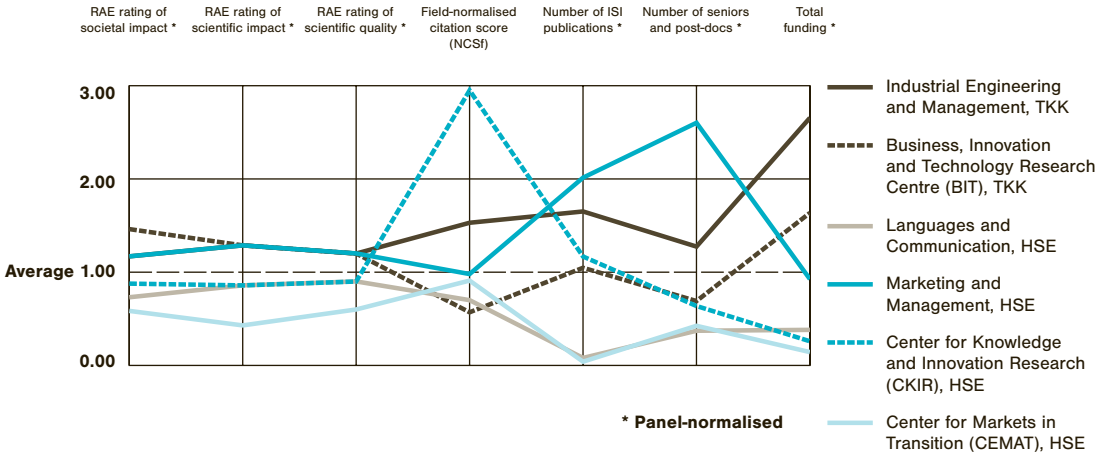


**Figure 5.8.5** Panel-normalised research indicators of the Units of Assessment in Panel 8 (1.0 is the average of Panel 8). NCSf is field-normalised and 1.0 is the world average in the field.

## Department of Industrial Engineering and Management, TKK

### *Introduction*

Research at the Department of Industrial Engineering and Management aims towards strong multi- and interdisciplinarity by combining technological, economic and organisational expertise. The Unit's research is organised into three research groups: (i) Industrial Management, (ii) Strategy, and (iii) Work Psychology and Leadership. The industrial management research group is concerned with different aspects of designing, managing and improving value adding processes. The research projects of this group are channelled through the BIT Research Centre. The strategy research group studies the interaction between firms and their stakeholders and related decision making processes. The work psychology and leadership research group combines quantitative, qualitative and philosophical approaches in analysing leadership and organisational and training practices in industrial settings.

### *Summary of Panel Assessment*

The Panel assesses the quality of research at the Unit to be, on average, at the very good international level, which is an excellent achievement. However, the Unit appears to lack a shared research vision and a strategic long-term plan for realising it, which makes it difficult to exploit the potential for cooperation between the Unit's main research areas of Industrial Management, Strategic Management and Work Psychology and Leadership. Moreover, the absence of a shared research strategy may contribute to the blurring of the demarcation between applied scientific research and commissioned consultancy work that the Panel observed at certain parts of the Unit. The impact on scientific community is assessed to be at the good international level, thanks mainly to the convincing citation rate of the Unit's top publications. The close working relationship between the Unit and Finnish companies provides the ground for the societal impact of research at the Unit to reach the very good international level.

To reach the world class in the Unit's field of research requires that the Unit manages to define a clear long-term vision for its research activities and a strategic plan (including at least systematic targeting of top outlets for publications, internationalisation of the research environment and shifting the focus of activities more towards cutting-edge theoretical research) for realising the vision.

### *Bibliometrics*

Although the ISI Web of Science database does not cover the Unit's activities as well as e.g. the Scopus database, the Bibliometric Analysis nonetheless supports the Panel Assessment, according to which the quality of the Unit's research is admirable. The Bibliometric Analysis highlights also the scientific impact of research at the Unit: The researchers publish in journals with citation impacts on average 34% above the field's global reference value,

and the Unit's field-normalised citation score 1.53 is significantly above the international average. 9.7% of the Unit's publications reach the top 5% of the field's most cited papers, giving evidence of international research leadership. This gives the Unit a solid basis to build on.

## Business, Innovation and Technology Research Centre (BIT), TKK

### *Introduction*

Founded originally to be the research centre of the Department of Industrial Engineering and Management, today BIT is an externally funded, independent centre focusing on academic research aimed at increasing the competitiveness of businesses and organisations in Finland. Recently BIT's activities have turned increasingly towards innovation and product development. BIT's multidisciplinary R&D projects, in which human activities combine with information and manufacturing technologies, aim to benefit all parties concerned in business, academia and public sector.

### *Summary of Panel Assessment*

As is the case with many other units, also BIT would benefit from explicitly defining a unit-wide strategy. Now it seems that BIT is in fact drifting towards focusing on applied research carried out for industrial partners and published in professional outlets, rather than focusing on more basic academic research aiming at high-level scientific publications. Notwithstanding this emphasis on professional practice, and although BIT reports to employ only three senior researchers, in the view of the Panel BIT has managed to reach the very good international level in research quality, thanks partly to ambitious doctoral students and professors working at BIT while affiliated with other units.

The citation rate of the publications is, however, somewhat low, which, together with the prevailing orientation towards Finnish industry, reduces BIT's impact on the international scientific community – although the good connections with many eminent academic institutions across the world secure a good level also in this respect. Nevertheless, BIT's characteristic strength appears to be the transfer of research-based knowledge and solutions from the academia into the business world: the societal impact of BIT's research can be considered to be at the highest, outstanding international level. The Unit can present an impressive portfolio of innovative business solutions and technologies, spin-off companies and external research funding. In summary, the Panel considers BIT to have an outstanding potential for becoming internationally a key player in its field of multidisciplinary research between the academia and the business world.

### *Bibliometrics*

The number of ISI publications (26) at the Unit is a slightly too small for the Bibliometric Analysis to yield reliable and comprehensive results. Although the ISI Web of Science database does not cover BIT's activities as well as

e.g. the Scopus database, the facts that in the ISI-based analysis the Unit's field-normalised citation score 0.57 remains significantly below the world-average and that also the other indicators struggle to reach the world and Aalto University averages, may nonetheless be considered to support the Panel's observation that the current research strengths of BIT are not easily measured by the traditional research impact indicators based on scientific articles and their citation rates. The situation could look different if the achievements of the professors affiliated primarily with other units but working factually at BIT were counted as BIT's achievements.

## Department of Languages and Communication, HSE

### *Introduction*

The profile of Department of Languages and Communication has changed during the past decade from a practically pure teaching unit to include a research component focusing on multilingual communication in business and management. The Unit's goal is to secure an established position in the international business and corporate communication research community in the near future. The Unit's research field is multidisciplinary and international by nature.

### *Summary of Panel Assessment*

The research active staff of the Unit is very small, although many members of teaching staff are committed to carrying out research even though it is not formally part of their work responsibilities. In the view of the Panel the Unit has succeeded in finding a research niche within its research field for which it is well suited, and the Unit has managed to publish in good journals. Thus, the quality of research of this small unit is rather high at the good international level. Although the Unit has a good reputation in the specialised business communication research community, the scientific and societal impacts of the Unit, reflecting the small size of the Unit, remain rather modest. The future potential of the Unit's research can be judged to be good, since the Unit has been able to define a "niche research strategy" that allows also a small unit to have a clear positioning in field. The main obstacle for realising the good potential is the small size of the research active staff and the very limited research support and resources the Unit receives from HSE or outside.

### *Bibliometrics*

Due to the very small number of ISI publications (2), the Aalto University Bibliometric Analysis is not applicable to the Department of Languages and Communication.

## Department of Marketing and Management, HSE

### *Introduction*

The Department of Marketing and Management comprises six academic disciplines: Economic Geography, Entrepreneurship and SME Business Management, International Business, Marketing, Organisation and Management, and Philosophy. The unifying theme is the focus on strategy in real life. The Unit aims at combining academic rigour with practical relevance as well as international academic debates with local contexts and traditions.

### *Summary of Panel Assessment*

The Unit has a clearly stated focus on strategy in real life, and its strengths include access to rich and unique databases collected from Finnish companies and its relationships with academic networks in North America and Europe that are currently being developed. The Unit is also rather multidisciplinary in itself, and collaboration across discipline boundaries is made uncomplicated within the Unit. Internationalisation of the research staff remains a challenge for the Unit.

The quality of research at the Unit is already at the very good international level. The Unit has made a strategic choice of emphasising high quality publications, and there is evidence of significant improvement in this respect in recent years. However, this is still an ongoing process and currently the scientific impact of the Unit's research, although good, fails to do justice to the quality of research at the Unit. On the other hand, the societal impact of research is already at the very good international level, mainly due to extensive and close working relationships with the corporate world. Factors hindering the Unit's ascent to the world-class of academic research include the dominance of short-term, small project funding, lack of diversity among research active staff and the fact that the commitment to the highest quality standards of research and academic publication is not yet ubiquitous at the Unit.

### *Bibliometrics*

The Bibliometric Analysis supports the Panel's assessment: the strategic choice of emphasising high-quality publications does not yet show very well in the Unit's results. For example, the number of ISI publications is still very small compared to the overall number of refereed articles (cf. Figure 5.8.3). Moreover, the Unit's ISI articles are published in journals with citations impacts on average 11% below the field's global reference value. The Unit's journal- and field-normalised citation scores (1.04 and 0.98, respectively) are practically at the world average. However, the Unit has already managed to get some of its publications into the top 5% of the field's most cited papers. This may support the Panel's view that the process towards a stronger impact on the international research community has started.

## Center for Knowledge and Innovation Research (CKIR), HSE

### *Introduction*

CKIR is an independent, multidisciplinary research centre that promotes scientific research on knowledge- and innovation-based renewal and growth of companies and societies. A particular research focus is on how knowledge is created by individuals, groups and networks in the context of a firm or in any other organisational, institutional, social, technological or societal context. More specifically, the research at CKIR has three focus areas: (i) global competitiveness through creativity and innovation: co-evolution of global firms with local innovation ecosystems, (ii) human-centric and user-experience-based media and communication including its impact on technology, and (iii) systemic innovations, including emerging industries and business creation, studied through human-centric, demand-driven and user-driven research, development and innovation (RDI) in open innovation ecosystems such as real-life "Living Lab" environments.

### *Summary of Panel Assessment*

CKIR's particular strength is laboratory experiments relating to the psycho-physiological responses to ICTs, media and services. The study of real-life contexts is another focus area. CKIR's performance is also greatly enhanced by the Unit's capacity to attract distinguished visitors and external research funding. Although the Unit's publication rate in high-quality journals is, on average, respectable, on closer inspection it turns out that a one single researcher, working mainly on experimental psychology, is responsible for a disproportionately large number of the Unit's publications. Moreover, it is mainly the publications of this researcher that are able to attract an impressive number of citations; the Unit's other publications must be content with a rather modest citation rate.

CKIR's researchers believe that their current work on the new RDI infrastructure will in the near future match CKIR's successes in human-technology interface research by leading to major international publications also in business, management and broader social science journals. Given the fact that CKIR is situated in a business school, the Panel emphasises this more recent line of research. Accordingly, the Panel appreciated the future potential brought about by the increasing role of this line of research even more than the earlier and current achievements, remarkable as they are, of a handful of researchers in the field of psycho-physiological laboratory experiments. Thus, taken as a whole, the quality of research at the Unit is assessed by the Panel to be at the good international level, while the scientific impact of this small Unit's research remains at the fair international level. The societal impact of research, currently at the good international level, could perhaps be expected to be higher, but as a relatively young unit CKIR has not yet been able to cumulate significant impact on society at large.

The future looks exceedingly bright for CKIR: The Panel considers the Unit to have an outstanding potential for ground-breaking discoveries in its

core areas and to become a flagship of Aalto University's multidisciplinary research. The research environment offered by the Unit is already at the very good international level, and the Unit has already demonstrated ability for forward-looking strategic thinking and for creating an intellectually stimulating and energetic culture of innovation. If the opportunities for synergy and cooperation with TaiK and TKK's comparable units (especially Media Lab and BIT) are carefully taken advantage of, then with suitable support the Unit's creative and multidisciplinary approach to research can elevate the Unit into an internationally recognised centre for novel research innovations.

*Bibliometrics*

CKIR's field-normalised citation index 2.95 is at the level of undoubted global excellence, and the Unit's articles are published in journals with on average 51% higher citation impact than the global reference value in the field. These remarkable achievements are based largely on the publications of a very few researchers working – exceptionally successfully – on psychological experiments: One single researcher is among the authors in 90% of the Unit's ISI publications.

**Center for Markets in Transition (CEMAT), HSE**

*Introduction*

CEMAT is an independent centre functioning on external funding and focusing on cross-disciplinary studies of emerging economies and rapidly growing markets from the point of view of institutional economics. A particular focus is on the institutional view of business strategy in the context of the rapid changes of the turbulent post-socialist and other quickly developing markets.

Within HSE's matrix model of organising HSE's research activities, CEMAT belongs to the horizontal axis formed by the four research priority areas and the separate centres. The vertical axis is formed by academic departments, where most of the basic research is carried out. The horizontal axis, in turn, serves to integrate existing research and to connect it better with external partners, and to apply HSE's research expertise to practical, real-life issues. Accordingly, an important aspect of CEMAT's activities is to provide both tailored research projects and ongoing monitoring of the economic development in the emerging markets in Russia, the Baltic States and Asia for customers both at the private and public sector that are seeking foothold at the target regions. The results of this work are often disseminated in research reports distributed widely within the information and expert networks in which CEMAT participates (including companies, chambers of commerce, etc.) rather than in academic articles (cf. Figure 5.8.4).

### *Summary of Panel Assessment*

CEMAT is a centre with a very large scope and very small number of (senior) research staff. The quality of research is at the fair international level. During the period 2003–2007, the Unit's current research staff produced only one ISI article. Thus, from the point of view of the international scientific community, the scientific impact of the Unit is minimal. The societal impact of the Unit's scientific research is not much higher; although the importance of the Unit's other activities may well be of considerable significance for the Unit's business partners. Due to the commitment and creativity of the research staff, the dynamic research agenda and the culture of flexibility, the research environment offered by the Unit is at the good international level, despite the notably inadequate resources and less-than-critical size of the Unit. Research-wise, however, the Panel does not see much international research potential in the Unit unless (i) the focus is shifted from applied regional studies into theoretically rigorous research targeting international top journals and (ii) the Unit is better resourced.

### *Bibliometrics*

Due to the very small number (1) of ISI publications, the Aalto University Bibliometric Analysis is not applicable to CEMAT.

# Panel 9: Architecture, Design, Media and Art Research

## Units of Assessment

**Department of Architecture,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

**Designium Innovation Centre,**
University of Art and Design Helsinki (TaiK)

**Future Home Institute,**
University of Art and Design Helsinki (TaiK)

**School of Art and Media Pori,**
University of Art and Design Helsinki (TaiK)

**School of Art Education,**
University of Art and Design Helsinki (TaiK)

**School of Design,**
University of Art and Design Helsinki (TaiK)

**School of Media Lab,**
University of Art and Design Helsinki (TaiK)

**School of Motion Picture,**
**Television and Production Design,**
University of Art and Design Helsinki (TaiK)

**School of Visual Culture,**
University of Art and Design Helsinki (TaiK)

## Overview

Panel 9 covered all the Units of Assessment at the University of Art and Design Helsinki (TaiK) and TKK's Department of Architecture. These units form multidisciplinary environments bringing together creative arts, academic research and professional practice.

The University of Art and Design Helsinki and TKK's Department of Architecture have a wealth of research skills, competencies and knowledge grounded in theory and practice of visual and creative arts. For the purposes of this assessment the units covered by Panel 9 included in the mapping of research active staff only staff members whose job requirements contain a research element and did not include those employed on the basis of their artistic work or practice. This means that the artistic or practice-led research characteristic of these units was not represented as comprehensively in

the Aalto University Research Assessment Exercise 2009 as it could have been and would have deserved to be. Accordingly, for most part the Panel was able to assess only conventional academic research carried out at the units, although this kind of research may in fact form only a part of the research efforts of the units. The characteristic features and quality of artistic research, however, have recently been addressed in the Academy of Finland's report *Research in Art and Design in Finnish Universities*, which complements the present evaluation.[23]

Since the artistic staff was not included in the research active staff, it is noteworthy that in Figure 5.9.1 the teaching staff includes many individuals whose artistic practice most probably includes artistic or practice-led research elements. Similarly, in Figure 5.9.5 the senior and postdoctoral staff comprises only individuals counted as members of the research active staff in the Aalto University Research Assessment Exercise 2009.

Moreover, it should be noted that the units in Panel 9 have produced so few ISI publications that the Aalto University Bibliometric Analysis 2003-2007 is not applicable to these units. Hence, in this Panel the research indicator figure (Figure 5.9.5) does not include the field-normalised citation score NCSf. Similarly, the sections on each Unit of Assessment exclude the section on Bibliometrics.

In addition to assessing the actual Units of Assessment, Panel 9 provided also a very helpful and rather lengthy commentary concerning TaiK and Department of Architecture and their research activities in general.

The main message of the Panel was that research in architecture, art, design and related creative arts disciplines should not be assessed in purely "scientific" terms that emphasise exclusively refereed journal/book outputs of staff with doctoral degrees. The research characteristically takes the form of practice-based research, which is typically animated by the role of the researcher as a practising artist or designer and, accordingly, involves approaches, methods and outputs that are in a critical dialogue with artistic practice and the customs of the art and design world. In these disciplines the value and impact of "artistic" activities should be on a par with those of "scientific" activities in counting towards the assessment. If this kind of practice-led approach to research is neglected, as it unfortunately was to a large extent in the Aalto University Research Assessment Exercise 2009, the true nature, quality and impact of research in core disciplines of the units assessed cannot be adequately understood and appreciated.

Another theme the Panel calls attention to is that TaiK as a whole appears to lack a clear and focused vision that is shared among the units. The units show a high degree of variability in understanding the future strategy of the University and their own strategic positioning in relation to it. The Panel felt that the overall vision for TaiK presented to the Panel was

23 http://www.aka.fi/en-gb/A/Science-in-society/Evaluation-of-research/Evaluation-of-disciplines-and-research-fields-/Evaluations-published--/

merely a survey of current activities and a desire to continue them, rather than an ambitious future vision derived from either top-level leadership or bottom-up determination. The Panel considered this to be a major drawback for TaiK. This is an issue the University of Art and Design Helsinki must consider seriously and thoroughly – especially since a convincing case could be made also for the view that it is precisely TaiK's heterogeneity based on the resistance to adopt all-encompassing visions and uniform practices that sustains the creativity and diversity characteristic to TaiK's innovative activities. However, if this kind of multifarious composition that turns away from shared strategies is at the heart of TaiK's self-identity, then this fact should be communicated openly across TaiK. The lack of clear and focused vision was also observed at the Department of Architecture.

Moreover, TaiK's Units of Assessment and TKK's Department of Architecture must learn to disseminate their research results internationally more effectively. In the main the Panel found the work of the units to be impressive and of world-leading quality. However, much of this work is published and disseminated exclusively by the home University and, accordingly, many of the outputs fail to reach the greater international academic audience and to have the impact on the international scientific community they ought to have. The research strategies of the University of Art and Design Helsinki and the Department of Architecture should give special emphasis to the importance of submitting research outputs for peer-reviewed journal or book publication through leading international publishers and of presenting them in international arena.

In summary, the University of Art and Design Helsinki and the Department of Architecture should define a research vision that builds on the excellent existing competencies but also extends beyond them to fulfil the potential afforded by the integration of Art, Design and Architecture in a Culture, Business and Technology context. Such a strategy should position Art, Design and Architecture as key elements in the formation of Aalto University's competitive tools.

**Basic Data concerning the Units of Assessment**

The following five figures represent selected facts concerning the staff, funding, and research publications and indicators of the Units of Assessment covered by the Panel.

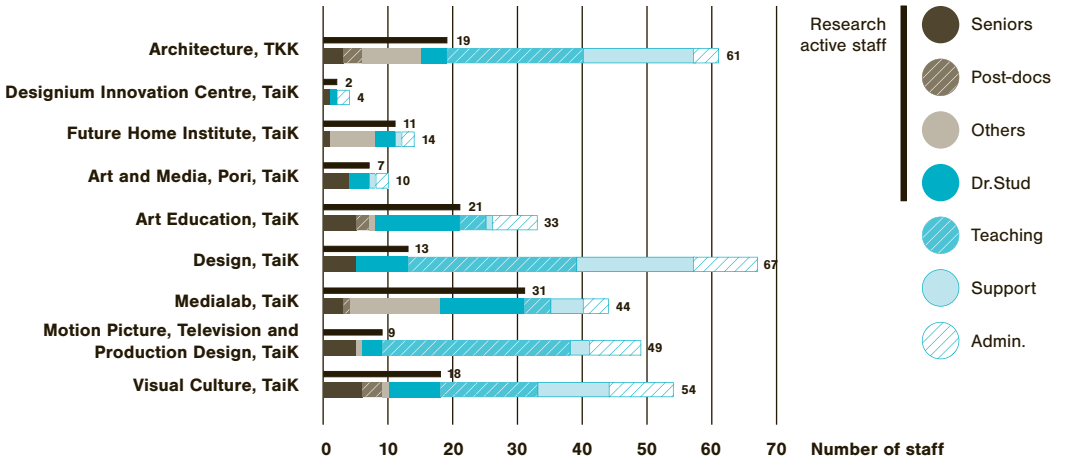


**Figure 5.9.1** Number of staff on the Aalto RAE census date of 1 October 2008.

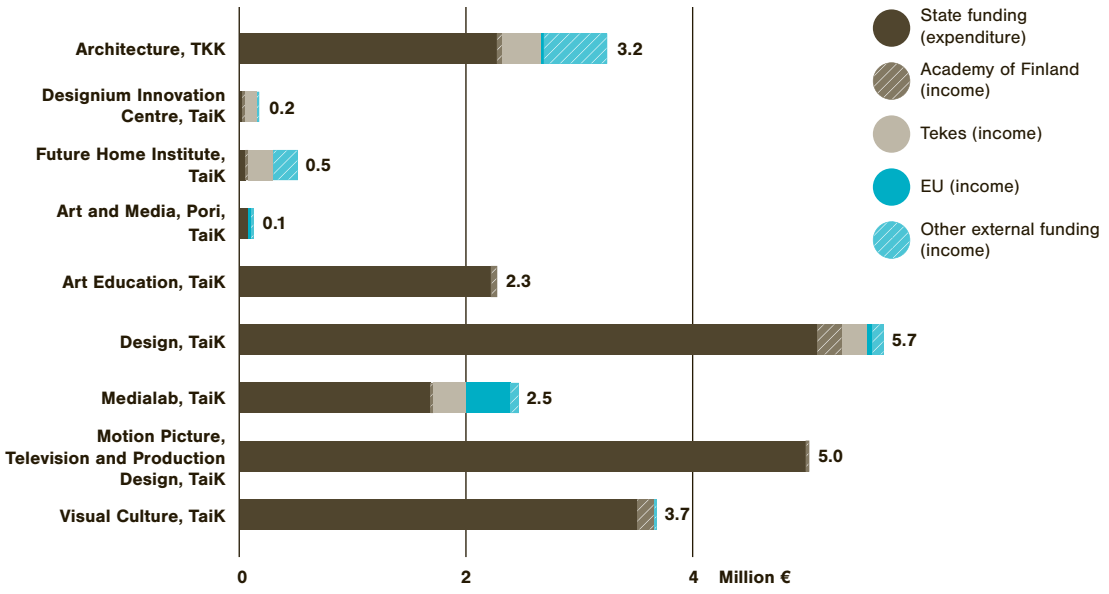


**Figure 5.9.2** Average annual funding during 2003–2008.

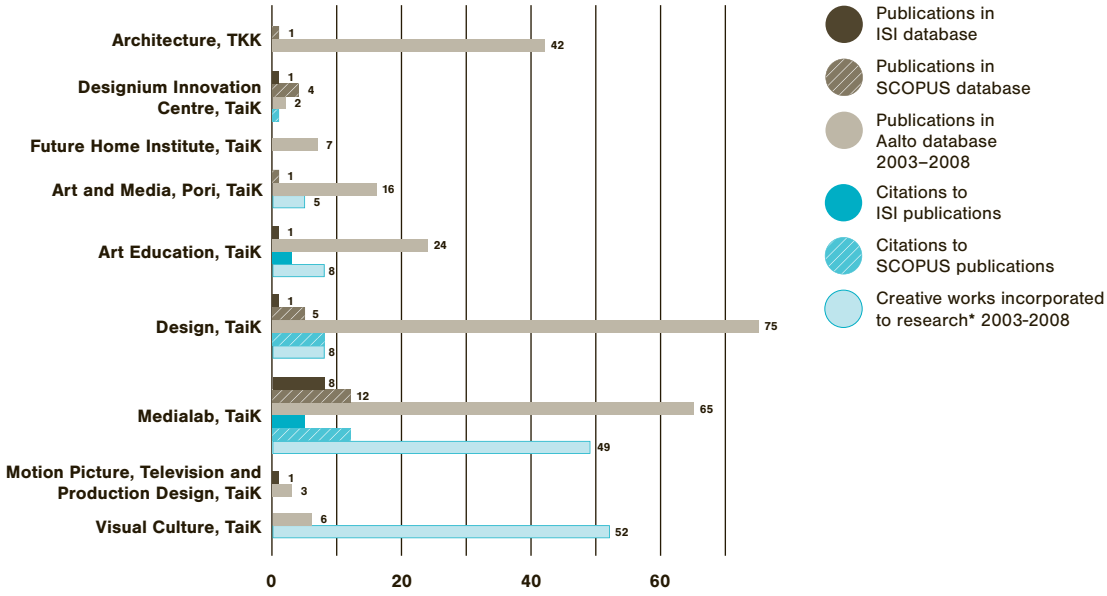


**Figure 5.9.3** Number of refereed international articles/conference papers in 2003-2007, number of international creative works incorporated to research in 2003-2008 and number of citations in 2003-2008. * This data was not collected from the Department of Architecture.

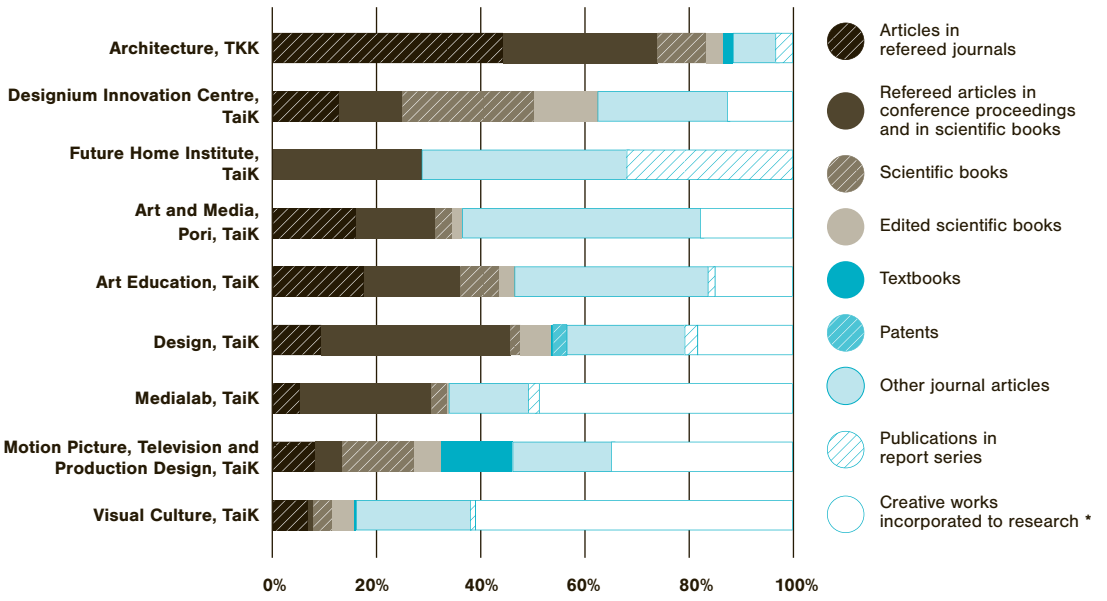


**Figure 5.9.4** Overall publication profiles 2003-2008.
*This data was not collected from the Department of Architecture, TKK.

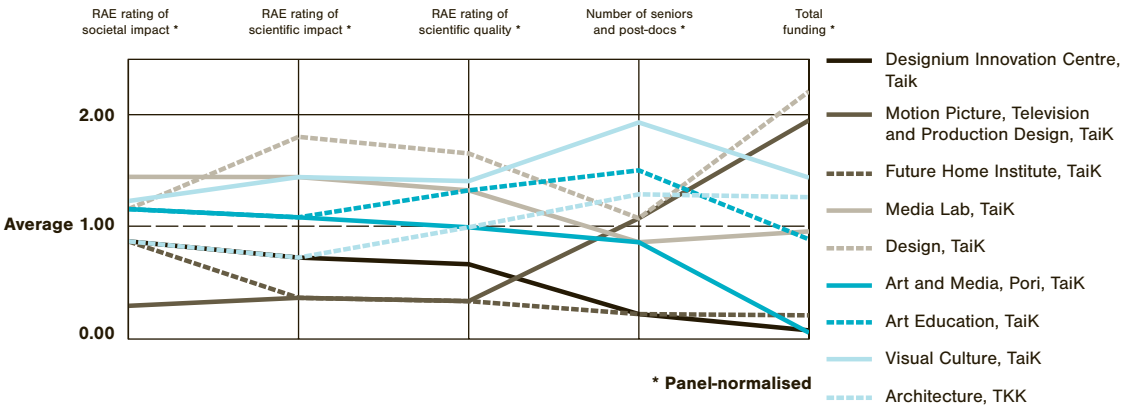


**Figure 5.9.5** Panel-normalised research indicators of the Units of Assessment in Panel 9 (1.0 is the average of Panel 9).

## Department of Architecture, TKK

### *Introduction*

The Unit is the oldest and largest of the three schools of architecture in Finland. Since 1872, the architectural education in Finland has followed the European tradition of education as part of the technical sciences, still being strongly identified by art and design. The Unit has degree programmes in architecture and landscape architecture, and doctoral education has been developed systematically since 1999. Finnish architectural education is in close contact with the professional practice of architecture and the social reality of Finland. Alongside this practice-oriented tradition the Unit has during the last decade intensified its research activity. However, at the moment only three of the eleven professors have a scientific qualification in addition to practical experience. The main fields and foci of research at the Unit are: Sustainable built environment, management of urban planning and design processes, planning theory, healthcare and welfare architecture, history of Finnish modernism in architecture, and ICT-enabled planning and design.

### *Summary of Panel Assessment*

TKK's Department of Architecture is one of the oldest schools of architecture in Europe. The internationally appreciated focus of the Unit has traditionally been on architectural practice and the education of respected professionals. The growing emphasis on architectural research and research education is a relatively recent trend at the Unit, and the Unit has not yet formulated a concrete strategy for research. Although the volume of research outputs is smaller than what one expects of a European school of architecture known for its high academic standing, the quality of research is at the good international level. The lack of a well-developed strategy for disseminating the research results in internationally visible and respected forums makes the scientific impact of the Unit's research to reach only the fair international level. The impact could be much stronger if the results were more often published in acknowledged, peer-reviewed journals.

A further factor hindering the development of the Unit's research culture is the unfortunate boundary between the Unit's research active staff and more practically orientated staff: practice-based research which recognises research contributions of practice and which could potentially build bridges between teachers, practitioners, researchers and even students has not yet found foothold at the Unit. The societal impact of research is at the good international level – although outclassed by the impact of the Unit's practical work. The future potential of the Unit is good: the Unit has defined several areas for their future development that build on the current strengths and partly on the synergies expected from the creation of Aalto University. Future development of the research aspect of the Unit requires a more robust strategic vision for the Unit, The Unit ought to establish much stronger research management for defining and implementing research strategies,

including strategies for national and international dissemination of research results and for internationalising the research environment.

**Designium Innovation Centre, TaiK**

*Introduction*

The mission of Designium Innovation Centre, since its foundation in 2000, is to promote the development of the national design policy and the internationalisation of Finnish design. The main goal is to make design a major global competition factor for the national economy. The Unit provides consultation services in all matters relating to the identification, analysis and protection of innovations. The services are available for the University's students and researchers, as well as for outside design entrepreneurs. The Unit also carries out applied and market-driven research aiming to support business development and applying design in strategic ways, in corporate R&D, marketing, communications and business innovation. In addition, Designium has special expertise in sustainable design.

*Summary of Panel Assessment*

The research active staff of this minute unit comprises only two individuals. The Unit focuses mainly on innovation services, supported by market-driven R&D activities. Thus, scientific research aiming at peer-reviewed publications is not a core function of the Unit. However, the Unit has produced scientific work of reasonable quality on an international level, but there is not enough of it to have a notable impact on the international scientific community. The reports on the strategic use of design in business produced by the Unit are influential among the Unit's multi-national business partners, which, given the Unit's nature, is a suitable impact channel for the Unit. This, and the Unit's international connections, ensures that the societal impact of the Unit is at the good international level. Developing greater presence in the international research community would require a major expansion of the Unit and a radical redefinition of its strategic mission.

**Future Home Institute, TaiK**

*Introduction*

The Future Home Institute is a multi-disciplinary research unit established in 1997. Its origins are in the Future Home research and development programme, a joint initiative of several public and private organisations and departments of TaiK, aiming at addressing the future challenges of housing and the domestic environment by combining approaches from architecture, product design and technology. The Unit conducts applied qualitative research in the area of living environments in close collaboration with the industry. The research activities are supported by a consortium of around 30 companies and institutions representing, among others, the fields of building and construction, housing services, furniture manufacturing,

home technology and ICT. During its history, the Unit has realised over 50 research projects. Circa 90 percent of the Unit´s funding comes from external sources.

*Summary of Panel Assessment*

This is a multidisciplinary research unit with an interesting overall framework and with no permanent faculty. The Unit runs on project-based model of funding, lacks organisational robustness and long-term strategic planning. Accordingly, the quality of research and the impact on the international scientific community are still on the emerging international level, while the societal impact of research has reached the good international level through the Unit's network of Finnish companies. The Unit could be seen to have a very good future potential as it resides at a potentially interesting intersection of research. However, in the view of the Panel this basic potential is seriously compromised by the lack of focus and strategic planning that could be pardonable for a very new institute but not for a Unit such as the Future Home Institute, which has already been in existence for more than 10 years.

**School of Art and Media, Pori, TaiK**

*Introduction*

The School of Art and Media Pori operates in the University Consortium of Pori, located on the West Coast of Finland. The Consortium is an interdisciplinary art and science community comprising departments of five different universities (Tampere University of Technology, Turku School of Economics, University of Turku, University of Tampere, and TaiK). The Unit is funded in large part by the City of Pori and by European Union programs in addition to the funding of the Ministry of Education. A Master's degree programme started in Visual Culture in 2004, and since 2006 doctoral studies have been offered. The Unit has two main research focuses that also reflect its particular regional conditions. The research topics related to visual culture explore a wide variety of phenomena in art, theory and media and especially their intersections. The second research focus has to do with the various facets of creative economy. It includes research on creative processes and immaterial production.

*Summary of Panel Assessment*

The small Unit, located in Pori, mixes visual culture and creative economy in an interesting and fruitful way. While this emphasis overlaps to a certain degree with the research interests of other TaiK units, the overlap is justified by the Unit's regional activities in the Satakunta area. The Unit is well connected internationally, and the Unit's Pori Artists in Residence programme gives further opportunities for internationalising the environment.

The Panel considers the Unit's research to be at the good international

level, which is a notable achievement for a small and very young unit. Accordingly, the Panel estimates the Unit to have very good potential to become a research unit of international importance in the future. This potential is based on the existing quality and relevance of the Unit's research projects on the one hand, and the Unit's societal impact (in particular, local and regional collaborations) that is already at the very good international level on the other. To further develop its characteristic strengths, the Unit might wish to consider emphasising cooperation with and attracting doctoral students from not only major international research units but also from organisations that share the Unit's interest in regional identity issues.

## School of Art Education, TaiK

### *Introduction*

The School of Art Education is a teacher-training institution that mainly trains visual art teachers for the official educational system, adult education and polytechnics. Art teacher training began in the year 1915. Research became part of the role in 1983 when doctoral studies were introduced to the curriculum. Aside from the didactic and strictly pedagogical research (that is done everywhere in teacher training units) the Unit seeks a breakthrough in two fronts: in the methodology of artistic research (research done by an artist using the skills and experience of artist's work as a part of the methodology), and the mediation of visual culture to society at large, e.g. in the welfare branch. The main foci imposed in 2008 for the future are research in art pedagogy, art and welfare, media culture, mediation of art, and art-based environmental education.

### *Summary of Panel Assessment*

The research output of the Unit during the assessment period is impressive, both in terms of quantity and quality, which the Panel considers to be at the very good international level as a whole. Several members of the Unit's very small senior research staff produce research at the highest, outstanding international quality level. The impact of the Unit's excellent research on the international scientific community, though good, is compromised by its publication mostly in Finnish. The Panel is convinced that both the quality and the subject matter of the Unit's research have very good potential for international publication and impact. The societal impact of the Unit's research is already at the very good international level.

In general, internationalisation is a challenge for the Unit. For example, the Unit does not appear to be able to match other TaiK units in its ability to attract international doctoral students. If the Unit is successful in meeting TaiK's benchmark for internationalisation of research, the Unit can be expected to gain the standing of an internationally leading unit in its field over the next years. The Unit exhibits high-level research leadership and solid strategic planning of its research activities, frustrated to some extent by limited resources and shortage of assistance and support services.

## School of Design, TaiK

### *Introduction*

During the last ten years, research has become an integral part of the School's strategy and it has also an important impact on education at all levels. The School of Design offers degree programmes in Ceramics and Glass Design, Applied Art and Design, Textile Art, Fashion and Clothing Design, Industrial and Strategic Design, as well as Spatial and Furniture Design, and the School coordinates the Design Connections Doctoral School. The research strategy of the School focuses on two main research areas, User-Centered Design and Design Studies. The School also supports research on other topics, but always aims at integrating these to the two main areas. Currently, user-centered design focuses on methodology, and building theoretical elements into design. Attention is paid to developing new methods like "cultural probes," co-design, and studies on co-experience and concept design. Design Studies covers research in design culture and history, urban space and artistic research. While user-centered design research mainly orients to technology and the social sciences, design studies build on the humanities.

### *Summary of Panel Assessment*

The research active staff of the Unit is very small, and there seems to be a rather profound schism between the Unit's research staff and the much larger staff of artistic practitioners and teachers. This split undermines opportunities for "research through design" and for other practice-based research approaches that could potentially be extremely fruitful for the Unit and that could better connect the Unit to the current international debates in the Unit's research field. Notwithstanding this shortcoming in the Unit's research environment, the Unit's research quality is already at the highest, outstanding international level. The Unit's work lead international design paradigms and thinking in several related fields. Accordingly, also the impact on the international design research community of the Unit's research is at the highest, outstanding international level. The books authored by the Unit members are widely used and cited as well as used as text books.

Due to fine strategic focusing on particularly important areas such as user-centred design, the Unit shows leadership in the international design research community despite the small size of the Unit's research active staff. The Unit's activities and contributions at the societal level are in the view of the Panel at the very good international level. However, the societal impact of the Unit's research is not yet as strong as its impact on the design research community. Given (i) the high-quality of the Unit's research and doctoral education, (ii) the readiness for innovative Aalto-level collaboration the Unit demonstrates, and (iii) the fact that the Unit is perceived as an esteemed partner both nationally, internationally and within the Aalto University, the Unit has very good potential to adopt consciously a leading international position and to become one of the Aalto University's flagships

in the foreseeable future. To realise this potential the Unit should enlarge its research active staff and to engage the artistic practitioners and teachers in the Unit's research effort.

## School of Media Lab, TaiK

### *Introduction*

Since 1994 Media Lab has provided education and research frameworks for studying digital media products, contents and technologies, their design, development and the effect they have on society. The research activities are organised through thematic research groups and projects, as well as through activities directly related to the studies of doctoral students. The Arki research group uses co-design and participatory strategies in the study and analysis of both positive and negative potential of digitalisation in the context of everyday life. Crucible studio's practice-based methodological approach explores drama, storytelling and narrative forms, in dialogue with their traditions, as means of communication in new and emerging media environments and cultural practices. The Systems of Representation, SysRep, group makes use of a systems-based philosophy to study and analyse knowledge representation in digital artifacts. The Learning Environments, LeGroup, undertakes design-based research whereby theories of learning serve as the basis for the creation of experimental learning environments.

### *Summary of Panel Assessment*

The Media Lab research community produces a wide variety of research outputs from peer-reviewed articles to performances, from exhibitions to software and games platforms. The quality of research at the Unit is at the very good international level, and many research outputs serve as references in their respective fields. In general, the Unit's research is well-viewed internationally, and the Unit has a solid position in international research networks. Hence, the scientific impact of the Unit's research can be considered to be at the very good international level. This strength is well supported by the Unit's doctoral programme, the organisation of which is exemplary. The Unit's success in obtaining external research funding from a variety of sources is very good, which gives evidence of the outstanding level of the societal impact of the Unit's research.

In summary, the Media Lab has an impressive track record and enjoys good international reputation. This gives the Unit outstanding potential for developing into an internationally leading unit in its research field. The main challenges on this path include increasing the theoretical depth and conceptual reflection in the Unit's research activities, which is an area that currently suffers from the dominance of short-term, contract-based research projects in the Unit's research portfolio.

## School of Motion Picture, Television and Production Design, TaiK

### *Introduction*

The Unit celebrated its 50th year of activity in the autumn 2009. It has two degree programmes with 10 areas of specialisation, and the doctoral school Elomedia – Postgraduate School in Audiovisual Arts. During the last two years research projects were initiated in screenwriting, interactive cinema and 3D and scenography. The Unit strives to strengthen methodological and epistemological basis of practice-based or artistic research in film and scenography. Research carried out at the Unit aims to combine conceptual approaches to the artistic work, to articulate and understand the tacit knowledge of filmmaking and scenography, to examine critically working habits and methods, and also to apprehend the social and cultural context of film, television and scenography.

### *Summary of Panel Assessment*

The Unit appears to have a strongly professional orientation with little evidence of a distinct research profile. This leads, for example, to inability to present the Unit members' impressive professional standing and production achievements such that the practice-based research component of these achievements would become visible. The Unit needs a robust and engaged leadership informed by a vision of production as artistic, practice-based research such that the professional and practical activities of the Unit become integrated into TaiK's research activities and research outputs, including dissemination of outputs in international journals. Currently the Unit's research remains too parochial, reaching only the emerging international quality level. Accordingly, at the moment the Unit's research fails to have a notable impact on the international research community. While the Panel concludes that also the societal impact of the Unit's research remains at the emerging quality level, the Panel nonetheless acknowledges that should the Unit learn to explicate the practice-based research element in the practical work of the Unit members, the societal impact of research could well be assessed to be at the very good international level.

The Unit must urgently focus on creating an infrastructure to support research by and through artistic practice. This requires proper leadership, management and strategic approaches to the Unit's research environment. In particular, it is of utmost importance that the Unit defines more of its professionally active staff as working in practice-based research, evidenced through production, exhibition, artifacts etc. Also the role of peer-reviewed articles and conference papers should be strengthened, particularly as part of doctoral education.

## School of Visual Culture, TaiK

### *Introduction*

School of Visual Culture provides BA, MA and doctoral programmes in environmental art, fine arts, graphic design, and photography. Diverse visual culture phenomena are studied on an interdisciplinary basis, and the strategy has been to recognise and encourage diversity in approaches. Despite this, during the past decade three substantial research foci have been established: (i) Art and 'Non-Art' studies aim to understand and develop artistic processes, to analyse artworks, art institution and artistic interventions in art contexts and beyond, including everyday aesthetics, (ii) Photography and Communication, and (iii) Communicative Design which includes design semiotics and graphic and media design. Only a part of the research results are communicated within traditional academic contexts. Research is also published through channels that are traditionally not considered scientific (curatorial work, exhibitions, displays, catalogue essays, reviews), even if these may have a considerable impact on scholarly discourses in their particular fields.

### *Summary of Panel Assessment*

This is a characteristically interdisciplinary Unit comprising graphic design, photography and art, including both practice within and reflective research on these areas. This breadth gives the Unit a solid base to develop inter-disciplinary research relevant for both artistic and research communities. The international esteem enjoyed in particular by the "Helsinki School of Photography" gives the Unit notable international presence.

The Unit faced the same problem that plagued also the other TaiK departments (and TKK's Department of Architecture) in this research assessment exercise, namely that much of the high-level practical activities of the Unit were left invisible to the Panel. However, even with this deficiency the quality of research at the Unit was above the very good international level. Had the research component of the Unit's impressive practical work been included in the assessment and explicated to the Panel, the Unit could well have reached the highest, outstanding international quality level. The same applies also to the scientific impact of the Unit's research, which nonetheless is clearly at the very good international level: the Unit's international contributions are truly impressive. The societal impact of the Unit's research is above the very good international quality level. The research staff and students figure very strongly in the national and international image culture.

The Panel believes that the Unit has outstanding potential for becoming a flagship of Aalto University's creative work. The developments required for fulfilling this promise include establishing more formal links with international partner institutions, actively supporting theoretically informed dissemination of the Unit's achievements in international outlets and developing the Unit's research leadership such that a long-term research strategy for the Unit can be defined and communicated to the different parts of the Unit.

# 6. Conclusions

## Assessment Process

The Aalto University Research Assessment Exercise 2009 (RAE) consisted of the following main steps:

- Planning of the overall process and the definition of the "Terms of Reference for Research Assessment Panels" (TOR) [24].
- Mapping of staff (census date 1 October 2008).
- Collecting research output data, including the articles and citations found in the ISI and Scopus databases.
- Self-assessments of the Units of Assessment.
- Selection of the Panel Chairs and Panel Members.
- Site visits, including writing the Panel Reports.
- Publication of the Panel Reports.

The overall assessment process succeeded well despite the tight schedule. One of the main aims of RAE was to provide Aalto University with essential information and recommendations regarding its strengths, potential and obstacles in research activities. The Panel Reports as well as the Self-Assessment Reports form an essential part in the process of defining the Aalto University's research strategy and developing its research practices, including the strategic allocation of research funds. The timetable of the University strategic planning required the Panel Reports to be available as early as in the summer of 2009.

In the self-assessments, the units were allowed to express their own ideas of the nature, quality and impact of their main research achievements, and their views on the strategic position and future potential of the unit. Moreover, the units' intensive input was needed even in the early stages, during both the mapping of staff and the collection of research outputs,

24 "Terms of Reference for Research Assessment Panels" document is available at Aalto University website at www.aalto.fi/aaltorae.

because the information in the various databases of the three universities was often either outdated or erroneous. To prevent similar difficulties in the future, it is highly recommended that Aalto University takes seriously into account the needs of future research assessments when planning its research output archives. The RAE project team also suggests that the number of professional titles of the staff would be reduced and the definition of doctoral student would be simplified.

Assembling high-quality peer-review panels is a demanding and time-consuming task. The tight time frame of the Aalto University Research Assessment Exercise, and the concurrent site visits of all the Panels added to the challenge. Having Panel Chairs and Members with wide-ranging expertise and experience in research assessments is undoubtedly a major asset for the RAE process, and we were very fortunate to receive 9 eminent Panel Chairs and 53 esteemed Panel Members of 20 different nationalities: the success of our RAE process is mainly due to their expertise and devotion to carrying out the assessment.

Two main problems may be identified in the assessment process. First, the "Instructions for Strategic Self-Assessment of the Units of Assessment" explicitly asked the units to explain their research excellence and its typical measurement methods within the research field of the unit. Nonetheless, collecting publication details and other research achievements as well as the "Terms of Reference for Research Assessment Panels" may have emphasised the traditional, scientific approach to such an extent that the Department of Architecture and the units at TaiK were, in fact, discouraged from presenting their 'non-scientific' research activities and achievements. Secondly, Panel 9 observed a gulf between the 'scientific' and 'artistic' staff at their Units of Assessment. This gulf was at times so wide that the 'artistic' staff seemed reluctant to even begin to explicate the academic or scholarly elements of their activities.

There are two lessons to be learnt from this in order to avoid such pitfalls in the future: first, the Aalto University community must learn to better recognise, appreciate and acknowledge artistic and other practice-based research and the different ways of verifying such research. Secondly, individuals and units engaged in practice-based research must learn to present their work so that its contribution both to Aalto University's research culture and to the generation of academic research outputs becomes explicit. Failure to achieve either of these goals would imply that Aalto University's unique potential based on the combination of science and creative arts is bound to remain unexploited.

## Assessment Criteria

The assessment criteria were defined in detail in the document "Terms of Reference for Research Assessment Panels". In addition to general observations of the units' research activities, the Panels were asked to assess the following aspects of research: quality, scientific impact, societal impact,

research environment and future potential. The Panels were asked to rate these aspects numerically on a scale of 1 to 5 and to justify the ratings in written statements. The Panels were instructed to rate the units in terms of their academic performance compared to the leading international units in the same field. It is worth noting that, in contrast to several Finnish university assessments, the point of reference for this assessment was world-wide high-standard research in each field, not simply European research.

The average ratings of all the five aspects were close to the midpoint (3) of the rating scale. The Panels, however, applied the whole rating scale thus being able to express the strengths and weaknesses at different Units of Assessment. This indicates that the "Terms of Reference for Research Assessment Panels" served the exercise well, and the assessment results can be considered credible and realistic.

Unlike other Finnish research assessments, a separate set of criteria was included for assessing both the scientific and societal impact of research to complement the criteria for assessing the quality of research. In general, this division proved very useful and formed one of the essential building blocks for the main conclusions of the Panels. However, the self-assessments of some units could have made a clearer distinction between the societal impact of their own research and their involvement in other societal activities.

## Main Results of the Research Evaluation Project

The Aalto University research evaluation project consisted essentially of two parts, the Aalto University Research Assessment Exercise 2009 and the Aalto University Bibliometric Analysis 2003–2007. Conducting two separate assessments at the same time, especially when based largely on the same data, offers a unique insight into the quality, impact and potential of Aalto University's research activities. The two methods complement each other in a fruitful way: the combination of the methods can shed light on areas that would have remained hidden if only one of the methods had been applied. In particular, the combination allows us to probe into the results and to analyse both the reliability of the methods and the factors contributing to the results. This was particularly important for the present proactive evaluation project aimed at furthering the definition of Aalto University's research agenda and enhancing its research performance.

The quality and scientific impact of research in the best-performing units, especially the Department of Applied Physics (TKK) and the Department of Information and Computer Science (TKK) were ranked as being of outstanding international level. In addition, the research environments of these units were assessed to be fully comparable to the best units in the world. This means that these units have the potential for being role models within the Aalto University research community. The Bibliometric Analysis did not, however, indicate such an outstanding performance, even though the Department of Applied Physics was close to being internationally very strong in terms of the field-normalised citation

score (the Crown indicator). It is worth noting, however, that this result is excellent for such a large department as the Department of Applied Physics and that, within the Department, there are groups that the Crown indicator indicates as globally excellent or very strong internationally. This is also true of the Department of Information and Computer Science.

It is a well-known fact that journals in general and ISI-articles in particular are not unequivocally the principal forums for disseminating research results in all disciplines. This is particularly true of the humanities, arts and multidisciplinary units. The difference has, at least to some extent, been considered in the Aalto University Bibliometric Analysis: the analysis was only applied to units with a sufficiently high number of publications and emphasis was put on field-normalised indicators. However, the results of the bibliometric analysis indicate that a clear shift of focus is required in the publishing culture of several Units of Assessment. Aalto University should treat publications in high-impact journals and citations to them as the key indicators for the quality and impact of research, whenever applicable.

The Assessment Panels identified societal impact as the main strength of Aalto University. Almost 70% of the Units of Assessment were ranked as being of outstanding or very good international level. Interaction with industry, in particular, was assessed to be at an excellent level. This is an important asset and a competitive advantage for Aalto University, even internationally.

However, the high societal impact of research did not correlate with excellence in research or its scientific impact: only one of the 12 units assessed to have a societal impact of outstanding international level reached the same level in the quality of research, while none did the same in the scientific impact of research. This was also indicated by the bibliometric analysis: only three out of the 12 units rose above the international average as measured by the Crown indicator, and none of these units reached the very strong international or the global excellence level.

The findings above lead to one of the main conclusions of the two exercises: although a strong emphasis on industry-oriented research is a real asset for the new University, it also forms a major threat for the ambition of Aalto University to become a world-class research university. A large part of the Aalto University research community is faced with the challenge of transforming its research culture from the prevailing opportunity-driven to a strategy-driven one. One of the driving forces for this change could be a deliberate choice to invest more in high-risk, long-term basic research.

Two other main challenges for the Units of Assessment as well as for University's management are internationalisation and the human resources strategy. In many units, the mobility of research staff is very low. Too many researchers have received all their academic degrees from the same university without spending even short periods abroad. An even greater challenge is the internationalisation of the research environment, particularly the recruitment of high-quality international experts to work at Aalto University.

The Panels found several world-leading professors and active doctoral students in the Units of Assessment. However, many senior and postdoctoral

researchers were found to be somewhat unmotivated and lacking proper career prospects. In addition, the mapping of staff revealed that approximately half of the research active staff of Aalto University consisted of doctoral students, an unfortunate situation typical of many Finnish universities. It is evident that becoming a world-class university requires the establishment of a new career system for Aalto University. Many Panels suggested a tenure-track system as the key solution. The issue was recognised early in the planning of Aalto University and placed as its top priority.

It is worth mentioning that the Aalto University Research Assessment Expert Panels emphasised the same challenges as two recently published national evaluations: *The State and Quality of Scientific Research in Finland*[25] and *Evaluation of the Finnish National Innovation System*[26]. Among other things, the lack of funding for high-risk, long-term research, a low degree of internationalisation and the structure of research active staff were described as major obstacles for enhancing the research quality and innovation system in Finnish research universities. The report published by the Academy of Finland states that incentives and funding criteria must allow senior researchers to take a more prominent role in Finnish research teams instead of doctoral students. This statement is perfectly in line with the conclusions of the Aalto University Research Assessment Exercise.

The Assessment Panels also recommended that the structure of the departments, and in some cases, also that of the faculty, should be evaluated thoroughly. There are several small units that do not reach the critical mass required for attaining better global visibility and excellence within a realistic time frame. Furthermore, some departments have been established around strong individuals rather than scientific disciplines. This leads to overlapping research activities in some areas and gaps in others. Structural reform is therefore a necessity for the success of Aalto University; discussions concerning such a reform will start during the year 2010.

## Strong Research Areas at Aalto University

The results of the research assessment project also gave an opportunity to initiate discussions about the possible research focus areas for Aalto University, and four areas of excellent quality were identified. These are, in alphabetical order:

- Advanced materials
- Computational science and modelling
- Design
- Information and communication technologies, and media

25 http://www.aka.fi/fi/A/Suomen-Akatemia/Julkaisut_/Julkaisusarjan-julkaisut/The-State-and-Quality-of-Scientific-Research-in-Finland/

26 http://www.tem.fi/index.phtml?l=en&s=3161

Materials research is carried out in all the four faculties of TKK. Research topics include microfabrication, nanotechnology, biomaterials, engineering materials and construction materials. In addition, in-depth understanding of the properties of various materials plays an important role in the design of e.g. sustainable ceramics and textiles, which are among the disciplines of the School of Design at TaiK. There are also excellent facilities for materials research available at the Otaniemi campus such as the Nanomicroscopy Center and Micronova, including clean rooms jointly owned with VTT. This brief list already clearly demonstrates the potential of Aalto University for advanced and synergetic utilisation of the wide expertise available in this area.

The research scope of the high-performing Department of Applied Physics and Low Temperature Laboratory includes materials science in a broad sense of the word. The Units' research covers areas from theory to synthesis and surface characterisation. Several groups working on various aspects of materials research within these units are at the very strong international level and a few even globally excellent. This provides a good starting point for wide-based cooperation within the University.

The expertise in computational science and modelling is concentrated in the Department of Applied Physics, the Department of Biomedical Engineering and Computational Science, the Department of Information and Computer Science, the Helsinki Institute for Information Technology (HIIT) and Low Temperature Laboratory. The research quality of all these units was assessed to be at an outstanding international level. The research groups of these units develop advanced computational methods and apply them to the study of problems stemming from other sciences and from industry. The systems studied vary from theoretical modelling and nanoscience to genetic regulatory functions and mobile phone activity.

In addition, several other research groups inside and outside TKK's Faculty of Information and Natural Sciences develop and apply modelling techniques. However, there is still a huge potential for applying the computational science methodology, e.g. to traditional engineering disciplines and to economics and business studies. Research already carried out in these fields within Aalto University could greatly benefit from a closer cooperation with the above-mentioned groups.

The research on usability, user-centered design, user experience design and domestication of design carried out at the School of Design at TaiK was assessed as being of outstanding international level and comparable to the best international groups in the same field. Integrating this research with a high-quality artistic practice-based approach provides a great opportunity for further development. Moreover, Aalto University creates brand new possibilities for this area of research to interact with various disciplines. In particular, user-centered design combined with sustainability and technology could form a starting point for a multidisciplinary engineering design approach, including media technology, within Aalto University and to contribute to economy and society in a new and innovative way.

The success of the Finnish ICT sector has been largely based on the long research tradition on information and communication technologies (ICT) at TKK. Its research has covered a wide range of topics from the fundamental aspects and mathematical methods of computation and of electromagnetic field modelling to many applications including wired and wireless networking and communications. Today, the key research groups, in addition to the world-class computational science units described earlier, can be found in the Faculty of Information and Natural Sciences and in the Faculty of Electronics, Communications and Automation. Together these units form a unique combination of expertise also furthering the renewal of the ICT sector. However, Aalto University offers opportunities for increased synergy. The combination of the theoretical and engineering ICT approach and user-centered design and content development application approach could create a platform for various new innovations combining elements of art, science and technology. The interface of digitalisation and new social practices is an example of such cooperation possibilities.

In summary, the Aalto University Research Assessment Exercise and the Bibliometric Analysis were designed to facilitate development of research at the University. The two exercises produced very valuable evaluations and observations about the research activities carried out in the assessed units of Aalto University. In addition, the Panel Reports contain useful critique and important recommendations for improvement in research performance. On the whole, Aalto University's research meets high international standards, its main strength being its high societal impact. At TKK, there are many outstanding units, but also many whose research is yet to reach world-class. As regards HSE, the Assessment Panels concluded that the transition from a professionally-oriented teaching institution into a research-oriented university has been successful. TaiK has a wealth of research skills, competencies and knowledge grounded in the theory and practice of visual and creative arts. Combining these with the research traditions of technology and business will catalyse the generation of new ideas and innovations for the benefit of society.

More than two thousand staff members were involved in the assessment exercises, which implies that the results concern a large part of the Aalto University community. The results presented in this report provide invaluable material for the strategic planning of Aalto University and are essential in shaping the new University. The units which were deemed best-performing in research will be awarded a special bonus for the years 2010–2012. Moreover, this report will be used, alongside the Assessment Panel Reports and the full Bibliometric Analysis Report, by the research community and the University management in their joint striving for excellence in research.

# Appendix:
# *Assessment Panels*

## *Panel 1:* Chemical Technology and Materials

### Panel Chair

**Dr. Jens Rostrup-Nielsen,**
Haldor Topsoe A/S, Denmark

### Panel Members

**Prof. Alain Dufresne,**
Grenoble Institute of Technology, France
**Prof. Mark Kortschot,**
University of Toronto, Canada
**Prof. Christina Moberg,**
KTH Royal Institute of Technology, Sweden
**Prof. Marja-Liisa Riekkola,**
University of Helsinki, Finland
**Prof. Hans J. Roven,**
Norwegian University of Technology, Norway
**Prof. Ana Maria Sastre Requena,**
Universitat Politècnica de Catalunya, Spain
**Prof. Erick Vandamme,**
University of Gent, Belgium

### Units of Assessment

**Department of Biotechnology and Chemical Technology,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Chemistry,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Materials Science and Engineering,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

**Department of Forest Products Technology,**
Faculty of Chemistry and Materials Sciences,
Helsinki University of Technology (TKK)

## *Panel 2:* Electronics and Electrical Engineering

### Panel Chair

**Prof. Mikael Östling,**
KTH Royal Institute of Technology, Sweden

### Panel Members

**Prof. Alex Gershman,**
Darmstadt University of Technology, Germany
**Prof. Maria Teresa Lago,**
University of Porto, Portugal
**Prof. Josef Lutz,**
Chemnitz University of Technology, Germany
**Prof. Wolfgang Mathis,**
University of Hannover, Germany
**Prof. Arthur van Roermund,**
Eindhoven University of Technology, the Netherlands
**Prof. Christer Svensson,**
Linköping University, Sweden

### Units of Assessment

**Department of Electronics,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Department of Radio Science and Engineering,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Department of Signal Processing and Acoustics,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Department of Electrical Engineering,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Metsähovi Radio Observatory,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

## *Panel 3:* Mathematics and Physics

### Panel Chair

**Prof. Arto Nurmikko,**
Brown University, United States

### Panel Members

**Prof. Eytan Domany,**
Weizmann Institute of Science, Israel
**Prof. Olaf Dössel,**
University of Karlsruhe, Germany
**Prof. Eric Isaacs,**
Argonne National Laboratory, United States
**Prof. Frank Pobell,**
Forschungszentrum Dresden-Rossendorf, Germany
**Prof. Joachim Rosenthal,**
University of Zürich, Switzerland
**Prof. Asle Sudbø,**
Norwegian University of Science and Technology, Norway
**Prof. Andrzej P. Wierzbicki,**
National Institute of Telecommunications, Poland

### Units of Assessment

**Department of Biomedical Engineering and Computational Science,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Mathematics and Systems Analysis,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Applied Physics,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Micro and Nanosciences,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Low Temperature Laboratory,**
Helsinki University of Technology (TKK)

## *Panel 4:* Computer Science and Information Technology

### Panel Chair:

**Prof. Ralph-Johan Back,**
Åbo Akademi University, Finland

### Panel Members

**Prof. Ian F. Akyildiz,**
Georgia Institute of Technology, United States
**Prof. Stefan Arnborg,**
KTH Royal Institute of Technology, Sweden
**Prof. Javier Rodrígues Fonollosa,**
Universitat Politècnica de Catalunya, Spain
**Prof. Seif Haridi,**
KTH Royal Institute of Technology, Sweden
**Prof. Judith Stafford,**
Tufts University, United States
**Prof. Raimund Ubar,**
Tallinn University of Technology, Estonia

### Units of Assessment

**Department of Media Technology,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Computer Science and Engineering,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Information and Computer Science,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Communications and Networking,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)
**Helsinki Institute for Information Technology (HIIT),**
Helsinki University of Technology (TKK)

## *Panel 5:* Mechanical Engineering and Automation

### Panel Chair

**Prof. Monika Ivantysynova,**
Purdue University, USA

### Panel Members

**Prof. Philip de Goey,**
Eindhoven University of Technology, the Netherlands
**Prof. Rein Küttner,**
Tallinn University of Technology, Estonia
**Prof. Torgeir Moan,**
Norwegian University of Science and Technology, Norway
**Prof. Margareta Norell Bergendahl,**
KTH Royal Institute of Technology, Sweden
**Prof. Jingzhe Pan,**
University of Leicester, United Kingdom

### Units of Assessment

**Department of Energy Technology,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Department of Engineering Design and Production,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Department of Applied Mechanics,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Department of Automation and Systems Technology,**
Faculty of Electronics, Communications and Automation,
Helsinki University of Technology (TKK)

## *Panel 6:* Civil Engineering and Urban and Regional Studies

### Panel Chair

**Prof. Nicolaas van de Giesen,**
Delft University of Technology, the Netherlands

### Panel Members

**Prof. Yvan Beliveau,**
Virginia Tech, United States
**Prof. Björn Birgisson,**
KTH Royal Institute of Technology, Sweden
**Prof. Armin Grün,**
ETH Swiss Federal Institute of Technology Zürich, Switzerland
**Prof. Riitta Keiski,**
University of Oulu, Finland
**Prof. Ali Madanipour,**
Newcastle University, United Kingdom

### Units of Assessment

**Department of Surveying,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Department of Structural Engineering and Building Technology,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Department of Civil and Environmental Engineering,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**The Lahti Center,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Centre for Urban and Regional Studies (YTK),**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)

## *Panel 7:* Business Technology, Economics and Finance

### Panel Chair

**Prof. Lawrence M. Seiford,**
University of Michigan, United States

### Panel Members

**Prof. Ritu Agarwal,**
University of Maryland, United States
**Prof. Fernando Ballabriga Claveria,**
ESADE Business School, Spain
**Prof. Joan Luft,**
Michigan State University, United States
**Prof. Jaap Spronk,**
Erasmus University Rotterdam, the Netherlands

### Units of Assessment

**Department of Accounting and Finance,**
Helsinki School of Economics (HSE)
**Department of Business Technology,**
Helsinki School of Economics (HSE)
**Department of Economics,**
Helsinki School of Economics (HSE)

## *Panel 8:* Marketing, Management and Applied Business Research

### Panel Chair

**Prof. Robert W. Grubbström,**
Linköping Institute of Technology, Sweden

### Panel Members

**Prof. Francoise Dany,**
EMLYON Business School, France
**Prof. Daria Gołębiowska-Tataj,**
Warsaw University of Technology, Poland
**Prof. Tatiana Kostova,**
University of South Carolina, United States
**Prof. Jo Mackiewicz,**
Auburn University, United States
**Prof. Peter Rosa,**
University of Edinburgh, United Kingdom
**Prof. Rajendra Srivastava,**
Singapore Management University, Singapore

### Units of Assessment

**Department of Industrial Engineering and Management,**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Business, Innovation and Technology Research Centre (BIT),**
Faculty of Information and Natural Sciences,
Helsinki University of Technology (TKK)
**Department of Languages and Communication,**
Helsinki School of Economics (HSE)
**Department of Marketing and Management,**
Helsinki School of Economics (HSE)
**Center for Knowledge and Innovation Research (CKIR),**
Helsinki School of Economics (HSE)
**Center for Markets in Transition (CEMAT),**
Helsinki School of Economics (HSE)

## *Panel 9:* Architecture, Design, Media and Art Research

**Panel Chair:**

**Prof. Rachel Cooper,**
Lancaster University, United Kingdom

**Panel Members:**

**Dr. David Bate,**
University of Westminster, United Kingdom
**Prof. Halina Dunin-Woyseth,**
Oslo School of Architecture and Design, Norway
**Prof. Arūnas Gelūnas,**
Vilnius Academy of Arts, Lithuania
**Prof. Kun-Pyo Lee,**
Korea Advanced Institute of Sciences and Technology, South Korea
**Dr. Sally Jane Norman,**
University of Newcastle, United Kingdom
**Prof. Marco L. Steinberg,**
Harvard University, USA
**Prof. Paul Wells,**
Loughborough University, United Kingdom

**Units of Assessment:**

**Department of Architecture,**
Faculty of Engineering and Architecture,
Helsinki University of Technology (TKK)
**Designium Innovation Centre,**
University of Art and Design Helsinki (TaiK)
**Future Home Institute,**
University of Art and Design Helsinki (TaiK)
**School of Art and Media Pori,**
University of Art and Design Helsinki (TaiK)
**School of Art Education,**
University of Art and Design Helsinki (TaiK)
**School of Design,**
University of Art and Design Helsinki (TaiK)
**School of Media Lab,**
University of Art and Design Helsinki (TaiK)
**School of Motion Picture, Television and Production Design,**
University of Art and Design Helsinki (TaiK)
**School of Visual Culture,**
University of Art and Design Helsinki (TaiK)