Publications of the Academy of Finland 1/10

Research Programme on the Application of Information Technology in Mechanical, Civil and Automation Engineering, KITARA (2005–2009)

Evaluation Report

Academy of Finland
Research funding and expertise

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Evaluation Report

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Page layout: DTPage Oy
ISBN 978-951-715-781-0 (pdf)

Contents

Description

Publisher	Academy of Finland	Date: August 2010
Author(s)		
Title	Research Programme on the Application of Information Technology in Mechanical, Civil and Automation Engineering, KITARA (2005–2009)	
Abstract	The Research Programme on the Application of Information Technology in Mechanical, Civil and Automation Engineering, (KITARA, 2005–2009) was launched by the Academy of Finland, Tekes (the Finnish Funding Agency for Technology and Innovation) and the Ministry of the Environment in 2005, and implemented during 2005–2009. The specific objective was to strengthen basic research expertise in the fields of mechanical, civil and automation engineering through the application of Information & Communication Technologies (ICTs). In 2010, the Academy of Finland appointed an international expert panel to evaluate the programme. The panel was asked to assess the programme as a whole, reflecting especially the following issues: Scientific quality of the programme, success of the implementation of the programme, contribution to researcher and expert training, collaboration and networking, applicability of research and importance to the users, and recommendations for the future. The panel found that programme had been successful in achieving most of its key objectives – namely increasing the scientific level and promoting basic research. The programme also helped to establish a number of new and very successful cross-disciplinary groups and collaborations. There were also good examples of potential significant benefits to industry. However, the panel perceived that the level of inter-national collaboration varied greatly between projects, and no improvement in the training and monitoring PhD students was in evidence. Overall, however, KITARA was considered to be a very successful multi-disciplinary and focused programme, that delivered considerable immediate and potential future benefits to both academic and industrial communities in Finland. The key recommendations were that the Academy should promote another focused cross-disciplinary, consortia-based call, although a PhD training programme and an awareness of the international State of the Art should be a requirement on the funding application. During the programme, formal mid-project reviews should be considered, and a single project leader is suggested for collaborative projects. It was also noted that the project documentation and statistical reporting needed a considerable overhaul, so that projects could be evaluated in a timely and rigorous manner; The use of Technology Readiness Levels (TRLs) may be useful in this respect. The panel also recommended supporting deeper collaboration by the greater use of ICTs, and creating sub-groups based on the subject areas of the call. Finally, six potential future research areas were distilled, aimed at leveraging the strengths and collaborations developed during KITARA, and taking Finnish research communities into new, complex areas in support of multi-facetted engineering systems.	
Key words	Research programme, evaluation, research funding, mechanical, civil and automation engineering, information and communications technology, manufacturing and construction engineering, real estate sector	
Name and number of series	Publication of the Academy of Finland 1/10	
ISSN	0358-9153	
ISBN	Print	Pdf: 978-951-715-781-0
Number of pages	55 p.	
Distributed by	Academy of Finland, POB 99, FI-00501 Helsinki, viestinta@aka.fi	
Published by	Academy of Finland	
Place and date of printing		
Other information	www.aka.fi/publications	

Kuvailulehti

Julkaisija	Suomen Akatemia	Päivämäärä Elokuu 2010
Tekijä(t)		
Julkaisun nimi	Research Programme on the Application of Information Technology in Mechanical, Civil and Automation Engineering, KITARA (2005–2009)	
Tiivistelmä	Suomen Akatemia, Tekes ja ympäristöministeriö käynnistivät yhdessä vuonna 2005 Tietotekniikan soveltaminen kone-, rakennus- ja automaatiotekniikkaan (KITARA) -tutkimusohjelman, joka toteutettiin vuosina 2005–2009. Ohjelman tavoitteena oli vahvistaa kone-, rakennus- ja automaatioalojen perustutkimusosaamista hyödyntäen ICT:tä. Vuonna 2010 Suomen Akatemia nimitti kansainvälisen asiantuntijapaneelin arvioimaan ohjelmaa. Arvioinnin tavoitteena oli tarkastella ohjelmaa kokonaisuutena ja erityisesti ohjelman tieteellistä laatua, ohjelman toteutusta ja tutkijakoulutusta, yhteistyötä, tulosten merkittävyyttä ja sovellettavuutta sekä antaa suosituksia tulevaa toimintaa varten. Paneeli arvioi ohjelman saavuttaneen menestyksellisesti useimmat tavoitteensa, kuten tieteellisen tason noston ja perustutkimuksen vahvistamisen. Ohjelmassa oli mukana monilla tavoin monitieteisiä ryhmiä ja yhteistyötä. Ohjelmasta löytyi hyviä esimerkkejä hankkeista, joilla on potentiaalia merkittäviin saavutuksiin teollisuudessa. Toisaalta hankkeiden kansainvälisen yhteistyön laajuus vaihteli paljon ja alan tohtorikoulutuksessa ja sen seurannassa on Suomessa edelleen parantamisen varaa. Kaiken kaikkiaan KITARA oli hyvin menestyksekäs, monitieteinen ja kohdennettu ohjelma, joka tulevaisuudessa selvästi hyödyttää akateemista ja teollista yhteisöä. Paneelin keskeisiä suosituksia ovat mm., että Akatemia käynnistäisi alalle uuden tutkimuskonsortiorakenteisen, kohdennetun ja monitieteisen haun ja että tutkimusalalle perustettaisi tohtorikoulutusohjelma. Paneeli suosittelee myös, että rahoitushakemukseen liitetään hankkeen vertailu kansainväliseen tasoon ja että ohjelmaa tarkasteltaisiin muodollisesti jo rahoituskauden puolivälissä. Arvioinnin mukaan tutkimushankkeiden dokumentointia ja tilastointia on parannettava, jotta niitä voidaan vertailla kansainvälisesti, yhteistyötä on tuettava ICT:n avulla ja ”Technology Readiness Levels” -mittaria voisi olla hyödyllistä soveltaa tutkimuksessa. Paneeli ehdottaa kuutta moniulotteista tutkimusaluetta uusiksi hauiksi.	
Asiasanat	Tutkimusohjelma, arviointi, tutkimusrahoitus, konetekniikka, rakennustekniikka, automaatiotekniikka, tietotekniikka, viestintätekniikka, valmistustekniikka, yhdyskuntatekniikka, kiinteistöala	
Julkaisusarjan nimi ja numero	Suomen Akatemian julkaisuja 1/10	
ISSN	0358-9153	
ISBN	Painetulle kirjalle annettu tunnus	Pdf-versiolle annettu tunnus 978-951-715-781-0
Sivumäärä	55 s.	
Julkaisun jakaja	Suomen Akatemia, PL 99, 00501 Helsinki, viestinta@aka.fi	
Julkaisun kustantaja	Suomen Akatemia	
Painopaikka ja -aika		
Muut tiedot	www.aka.fi/julkaisut	

Summary

The "Application of Information Technology in Mechanical, Civil and Automation Engineering" (KITARA) research programme – funded by the Academy of Finland, Tekes (the Finnish Funding Agency for Technology and Innovation) and the Ministry of the Environment - was set up to strengthen basic research expertise in the fields of mechanical, civil and automation engineering through the application of Information & Communication Technologies (ICTs).

This is the report of the International evaluation panel that has considered the programme as a whole in terms of scientific quality, success of the implementation of the programme, scientific and administrative coordination, contribution to researcher and expert training, collaboration and networking, applicability of research and the importance to the users. It also includes an evaluation of the administration of the programme and the review process.

The panel reviewed the programme documents and interviewed the key stakeholders in the KITARA activity, namely the funders, project leaders, researchers and PhD students.

The panel concluded that in terms of increasing the scientific level and promoting basic research that it has achieved its objectives and several of the applicants have increased their academic output and have been successful in terms of obtaining additional funding. Also it was noted that the programme had helped to establish some very beneficial cross-disciplinary groups and collaborations. It is hoped that these collaborations will endure.

However, it was felt that the requirements in terms of researcher and expert training and international collaboration and networking have not been achieved and the panel makes a number of recommendations in these areas.

The administration of the programme has been executed competently and the KITARA researcher meetings particularly were of good value, but additional focus could have further leveraged the networking value. However the programme documentation (delivered electronically to the panel members) was problematic. It consisted of nearly 4,300 pages and as such was very hard to use effectively as part of the review process. The panel therefore makes some recommendations for the critical documents that should be supplied for future programme evaluation panels.

Finally, the panel suggests that consideration is given to the use of Technology Readiness Levels (TRLs). These are being increasingly used in research and development communities. They will help the Academy and Tekes to coordinate and calibrate their various activities.

Overall, this has been a very successful multidisciplinary and focussed programme that will have considerable benefit to the academic and industrial communities in the future. It is strongly recommended that the Academy funds further activity and the panel suggests a number of potential state of the art areas for consideration.

1 Introduction

The "Application of Information Technology in Mechanical, Civil and Automation Engineering" (KITARA) programme was conceived in 2004 and had a number of key objectives associated with developing a cross-sector, multi-disciplinary research programme associated with increasing the amount of basic research being undertaken by the engineering research community and by incorporating a research focus associated with Information and Communication Technologies (ICTs).

This introduction of the evaluation report summaries the thinking behind the KITARA programme and then describes the process of evaluation and the criteria that the panel used.

1.1 The KITARA programme

The stated aim of the programme was to *"strengthen basic research expertise in the fields of mechanical, civil and automation engineering through the application of ICTs: this will further strengthen the international competitiveness of a cluster that makes a significant contribution to the national economy. The programme will seek to create innovative and internationally competitive basic research across disciplinary boundaries and to support the development of new multidisciplinary research groups and national and international networks of cooperation. In keeping with the strategies of different actors within the mechanical engineering and construction cluster and the funding bodies involved, cooperation will be aimed at strengthening and diversifying basic research and tying it in more closely with these branches' development visions."*

Thus the underlying ethos of the research programme was to create and establish a culture of *basic* research in the fields of mechanical, civil and automation engineering, to support postgraduate training in these fields and to *liven up* their rather traditional image and give them greater appeal.

The new knowledge generated in the research programme was also to provide a platform for new solutions, applied research and the attainment of environmental objectives. The programme particularly wanted to encourage cooperation between ICT and mechanical engineering, construction and/or automation experts.

Target areas for new information and knowledge were in the development of intelligent structures and products and the generation of basic knowledge and expertise for the implementation of innovative and efficient control systems at the system and process level.

Key aspects that were emphasised in the programme were wide ranging and included life-cycle thinking, environmental friendliness, energy efficiency, good health, good and sustainable planning practices, reliability, condition monitoring and the meaning of a healthy social/built environment, ease of use, operational reliability and the improvement of safety and maintenance of overall safety at different stages of a product's life-cycle. The level of funding and timescales have been distilled from the documentation by the panel and are included in Appendix A.

1.1.1 The Four Focus Areas

The broad ranging aims described above were distilled into four focus areas. These are listed below. The paragraphs in italics were made available to the applicants and were used by the assessment panel as part of the evaluation process. Appendix B shows the panel's view of the coverage of these four focus areas by the 15 projects. This is discussed in more detail in Section 2 (Implementation).

a) **ICTs that support design, manufacture and use:**
Information technology has become an important tool in the design of products, processes and services. Product modelling, process simulation and the incorporation of life-cycle factors in the design process help to create greater coherence between design, process and maintenance and by the same token to improve overall manageability. Information technology can help to improve both the quality and speed of design. Virtual prototypes can be used to test various application scenarios without needing to build mechanical prototypes or scale models. The information network allows for geographically decentralised design. The joint online use of simulation models describing different aspects of a machine or building opens up new opportunities, but is also very challenging.

b) **ICTs incorporated in the product:**
In the future, information technology will be incorporated as an integral part of the product, adding new features and uses and making the product easier to use. More and more, users will require of machines and production systems an ability to adapt to variable, rapidly changing, unpredictable situations. Diagnostics and prognostics are key features of products and systems that have the capacity to learn and adapt to variable situations. Measurement data can be translated in real-time into corrective action in order to eliminate or prevent faults and malfunctions.

c) **Life-cycle management and its networking in business companies and systems:**
ICTs have a central role to play in life-cycle management. Management of the life-cycle of buildings is a real estate business that is undertaken in practice by an extensive network of business companies and systems. Features can be incorporated in products and services that through their life-cycle efficiency add significantly to productivity and create completely new innovations. ICTs make it possible to modify a product or production system during its life-cycle, to improve their properties or to add or activate new features by means of software modifications or plug-ins that can be supplied online. The changes required and opportunities offered by the information and service society in the life-cycle management of the existing built environment will be even greater than those seen in the construction process. ICTs will also allow for the integration of the data contents concerning building production and building use and so pave the way to trading based on life-cycle features.

d) ICTs that support interaction between users and building/machine and the changing environment of use:
In the interaction between man and building and between man, machine and the changing use environment, ICTs have a crucial role to play in processing and representing information to users in a readily intelligible format. Interaction aims at user-friendly design and an interface that adapts according to the end-use or user characteristics. The interaction can take place either in situ or via a remote connection. The main emphasis in interaction is on diverse user interfaces.

1.2 The Evaluation Process

The international evaluation panel consisted of the four members listed on the title page. The evaluation process took place on 14–15th June 2010 in Helsinki and consisted of three stages: i)Receiving and assessing of project documentation, ii) interviews with key stakeholders and participants and the generation of recommendations and iii)jointly preparing this evaluation report.

Assessing the project documentation included examination of the supplied material, including:

- Background on the Academy of Finland, brochure, funded programmes and research programme strategy
- Basic KITARA programme information – the memorandum outlining the original call, list of funded projects, etc.
- Programme manager's evaluation report
- Examples of the annual seminar programmes
- Report of the Academy of Finland into Mechanical Engineering, plus some other evaluation reports
- Press material consisting of three press releases
- Annual reports, final reports and self-evaluations (final reports and self-evaluations were completed for each project leader (incomplete for some projects)
- Original research plans (8 of 10 projects)
- Information on members of the steering groups

The details of the supplied documentation are available in Appendix C. In addition, short presentations were received and discussions with funders, project leaders, researchers, the programme steering group and other key stakeholders were undertaken during the panel meeting. The list of participants and agenda of the evaluation meeting are included in Appendix D, with the steering group members listed in Appendix E. The panel evaluated the programme against the criteria listed below received from the Academy; the recommendations (Section 7) are made against these criteria.

Scientific quality of the programme

- Scientific quality of the programme
- Scientific quality and innovativeness of the research
- Scientific competence of the consortia

Success of the implementation of the programme
- Concordance with the objectives of the research programme
- Functioning of the programme
- Added value of the programme
- Contribution to enhancing inter- and multi-disciplinarity in research
- Scientific and administrative coordination

Contribution to researcher and expert training

Collaboration and networking
- Collaboration within the programme, especially interdisciplinary collaboration
- Collaboration with other Finnish groups
- International cooperation
- Collaboration with the end-users

Applicability of research and importance to the users
- Contribution to promoting the applicability of research results
- Relevance and importance to the users
- National and international

Recommendations for the future (including the justification for the recommendations)

1.3 Elements of the Report

This report is broken down into five main elements that deal with Implementation, the Scientific level, Trained output, Collaboration (which includes applicability and links to industry) and Documentation/Reporting. Note that the criteria *"applicability of research and importance to the users"* is assessed throughout the sections (and particularly in the Scientific level, Trained Output, Collaboration and Documentation sections). The report then finishes with a combined section that emphasises again the overall conclusions and recommendations for the future, including six potential research areas for the Academy to consider for future programmes.

2 Implementation

This section of the evaluation report addresses the implementation and management of the KITARA programme, from inception to completion.

2.1 Implementation Overview

From the review of the KITARA programme documentation and the interviews it became clear that the KITARA programme enabled many researchers to start scientifically rigorous research in a new area. Many researchers also reported that the KITARA programme enabled them to embark on new collaborations, in many cases with researchers outside their traditional disciplines. The panel felt that these impulses for new research areas, directions, and collaborations were one of the most significant achievements of the KITARA programme. Several consortia achieved world-class multi-disciplinary scientific collaboration. When this was the case, the outcome in terms of direct scientific contributions and in terms of establishing a strong foundation for future research was also on a very high level.

The evaluation panel commends the collaboration between the Academy and Tekes (and the Ministry of the Environment). The selection of consortia and projects was coordinated well between these funding agencies. The panel recommends, though, that for future programmes that are funded jointly, some linkage between the consortia be maintained over the course of such programmes.

The implementation guidelines seemed to allow for sufficient flexibility in shifting the timing of programme funds to adjust the research schedule in response to slower or faster completion of research elements. Such flexibility is particularly critical for an effective use of funds by consortia. The panel was surprised to learn that some consortia did not use this flexibility to adjust the research schedule (and with that the timing of the allocation of the KITARA funds) to enable the consortium to continue the work necessary to accomplish the research scope, but rather chose to adjust the research focus to stay within the schedule.

The steering group's role was critical in selecting an appropriate portfolio of consortia and projects in support of the aims of the KITARA programme. Appendix B suggests a good balance was achieved. The evaluation panel felt, though, that the role of the steering group during the execution of the programme was slightly weak, in particular in light of the high calibre nature of the members (Appendix E). The steering group seemed to focus mostly on bureaucratic matters and less on programmatic success. It recommends that, for future programmes, the Academy consider an expanded role of the steering group during the programme, such as: organising a serious mid-term review, setting and following up on reporting criteria that better indicate programme success and highlight areas for improvement, helping to create synergies between consortia and between academia and industry, maintaining the focus of the programme, including the connections between the consortia's intermediate and final results and the impact of the programme, and fostering the proactive dissemination of the programme's results and findings.

Expanding on the previous point, the evaluation panel noted that the programme management should not only focus on tracking status reports, but should manage the programme from inception to completion so that the programme goals are not only considered in soliciting and selecting consortia and projects, but also in disseminating the results and in fostering collaborations between projects and consortia.

2.2 General Recommendations

In addition to the comments above, the evaluation panel recommends two areas for improvement for future similar programmes:

- Ensure that the leadership of each consortium is clearly established
- Use modern ICT methods to support project, consortium, and programme management

For several consortia, the panel found that it was not clear who the designated leader was. The requirement to submit separate project-specific annual reports to each funding agency (The Academy, Tekes, and the Ministry of the Environment) reinforced this apparent lack of leadership in some of the consortia. For future programmes, the panel recommends that the Academy outline specific requirements for leadership of a consortium. The panel recommends that one professor fulfil the role of Principal Investigator for a consortium. This would also allow for more succinct documentation (See Section 6).

Secondly, the evaluation panel found it curious that modern ICT methods (wikis, intelligent databases, collaboration tools, etc.) were not used to support the management of the consortia and the whole programme. Whilst some consortia were largely co-located, an opportunity was missed to showcase modern ICT methods for programme management, create a demonstration project for the Academy and the KITARA participants, and reach potential stakeholders with the research results.

3 Scientific Level

This section addresses the panel's perception of the Scientific level of the programme. Firstly, the panel notes that the ambition to *"strengthen basic research"* in the engineering disciplines seems to have been successful: *"The programme allowed us to do more basic research"* or *"gave incentive to do more basic research"* are typical quotes from interviews with project leaders in the programme. Another indication is that 7 of the 10 funded Academy consortia have been awarded new funds in competition with other research institutions in the Academy's general call for funding in 2010. This is commendable and a very good outcome.

3.1 Publications

The scientific level is normally measured by publications in high-quality refereed journals, numbers of PhDs awarded and in applied research fields also by the number of patents, start-ups or other indicators measuring the impact on industry and society. Figure 1 shows the relation between different categories of reported publications from Academy-funded consortia (10) and Tekes funded consortia (3[1]):

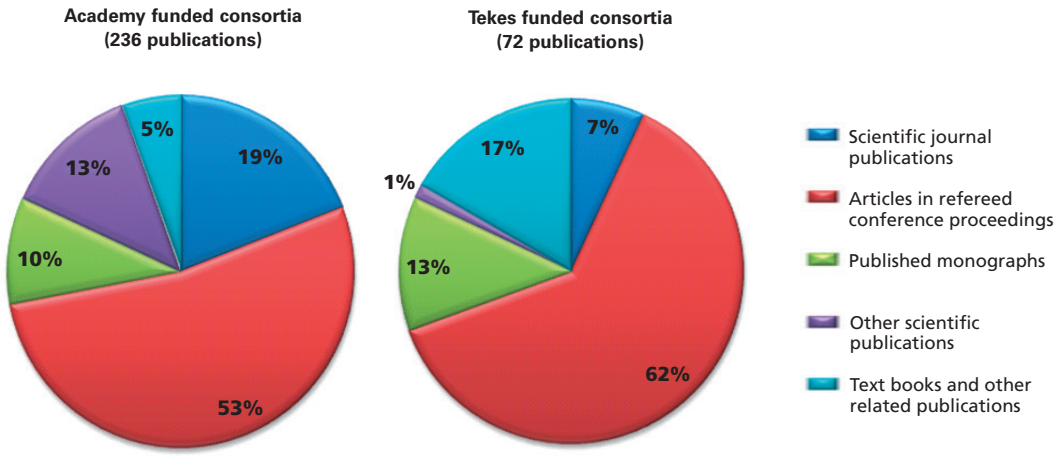


Figure 1. Number and type of publications

In relation to Tekes-funded consortia, the Academy-funded consortia had relatively more publications in refereed scientific journals. The total output is at a reasonable level but the variation between the different consortia is large. The number

[1] At time of evaluation only 3 consortia out of 5 funded had submitted the final report.

of journal publications varied from 0 to 10 (mean 4,5) in the Academy-funded consortia and between 0 to 5 (mean 1,7) in Tekes-funded consortia. The numbers of degrees awarded follows the same trend: The consortia with the highest publication rates also have the highest number awarded degrees (see section 4, below).

Finally, a general observation of the scientific output is that the most successful consortia have intense collaboration between the different research groups in the consortium, high publication rate with often jointly written papers and many awarded degrees. This is also often manifested in patents or applications ready to be implemented (e.g. EMPRONET, ITCEE, QUALITY) or close co-operation with industry (e.g. FC-ICT). The panel therefore sees no contradiction between basic and applied research. On the contrary, it is argued that basic research is a condition for successful applied research and implementation.

3.2 Publicity

One of the drivers of the KITARA programme was to increase public awareness of science, technology and engineering by engaging with various types of popular media. The panel noted some excellent examples of this, with television interviews and newspaper/magazine articles etc. However, whilst it was clear that some consortia had engaged effectively with the media and the general public, it is unfortunate (although due to their different nature, inevitable) that not all consortia were so engaged. It is recommended that for future projects, a holistic measure of 'impact' be developed, to include an assessment of engagement with popular media, together with the number and type of publications.

3.3 General Recommendations

The panel interviewed members from five different consortia and saw examples of some very dynamic activity from well integrated teams working at challenging technical boundaries. A number of these were addressed by the linking together of different disciplines – a clear justification for (and achievement of) the approach encouraged by KITARA. This was also seen in the final reports and self-evaluation forms. However, the panel also saw less good work and much less effective co-operation and integration.

The panel therefore makes two recommendations associated with the scientific level. The first is associated with encouraging more of the dynamic activity described above via a KITARA follow-on project that leverages the existing strengths evident in this programme (civil and mechanical/automation engineering and ICT).

To deal with the less successful examples observed by the panel, it is recommended that the consortia leadership be addressed (see Section 2) – that is, there needs to be a single person responsible for the effective delivery of the programme. Associated with this is the issue of the creation and monitoring of a range of metrics to allow more effective assessment of consortia against international standards (see Section 6). As well as allowing more effective self-evaluation during any future programme, it would allow provide future evaluation panels to assess more quantitatively and transparently the scientific level.

4 Trained Output

One of the stated objectives of KITARA was to improve doctoral training. Further, the quality of doctoral training was highlighted in the evaluation of mechanical engineering research in Finland (ISBN 978-951-715-699-8), which recommends more attention be paid to this area – specifically that *"a more controlled programme for completing the PhD should be implemented. PhD students should be guaranteed to do research at a level of about 80% of their time. They should also have a structured plan from the beginning of their programme for 4–5 year completion. This plan should be updated and revised on a regular basis, and appropriate action should be taken at the departmental level if deviations from the plan become excessive."*

The number of PhD degrees, Licentiate degrees and MSc's awarded from work carried out with KITARA funding are summarised in Table 1, below. As noted in Section 3, whilst the overall level is reasonable, the variation between consortia was large (for no apparent reason). Consortia with higher publication rates also appeared to produce a higher number of degrees. A partial list of the degrees awarded (as recorded by the Academy's online system) may be found in Appendix F.

Table 1. Awarded degrees in the KITARA programme

Consortia funded by	PhD degrees	Licentiate degrees	MSc degrees
Academy (10)	**19**	**7**	**21**
Tekes (3)	**2**	**2**	**4**

As well as evaluating the number of theses produced from the KITARA programme, two PhD students were interviewed by the panel. Although it is noted that the report quoted was published in 2008 (after the start of the KITARA programme), given the stated aim of KITARA to improve doctoral training, the panel was disappointed to conclude that there was little evidence that this had succeeded. Specifically, a more structured plan for PhD students did not appear to be in operation. The panel therefore re-iterates strongly the advice of the report quoted above. However, the panel noted the positive response and good involvement of the PhD students to the annual seminars (see Section 5, below).

Several consortia members also commented on the self-evaluation forms about difficulties recruiting suitable doctoral candidates. Therefore, most interviewees were asked about recruitment issues. This gave a mixed picture, with some perceiving problems, whilst others did not. Further, there appeared to be no clear correlation between recruitment difficulties and particular subject areas.

4.1 General Recommendations

The panel fully endorses and re-iterates the recommendation of the report quoted above – namely that a more structured approach to PhD training be implemented as a matter of priority. This should be a stage-gated process, with clearly defined milestones and metrics. The PhD roadmap from the University of Bath in the United Kingdom is reproduced in Appendix F as an example. It is recommended that other processes from a range of international institutions be benchmarked.

Further, the panel recommends that the Academy is appropriately placed to take a more pro-active approach in this area, ensuring that issues surrounding the training of students be included in funding applications (see Section 6), and that the successful and timely completion of degrees is included as a measure of success in the intermediate project reviews (see Section 2) and the final project output. Whilst the mixed nature of the picture gained by the panel in relation to recruitment issues means that the panel simply recommends further investigations into this area, a more structured programme with a clear progression route through the PhD process and beyond, into an academic career could well provide an incentive for potential students to embark on a career in research.

5 Collaboration

One of the strong motivations for the KITARA programme was the cross-disciplinary approach of bringing ICT as well as mechanical engineering, construction and/or automation groups of experts together in the project consortia and foster links with industrial partners. This section provides an overview of the panel's findings in these areas.

5.1 Level of Collaboration

This section provides an overview of the panel's impression of the level of collaboration with academia (within consortia and in a wider context), industry, and internationally.

5.1.1 Academic Collaboration

The results from the self-evaluation forms and the interviews from selected consortia members produced a somewhat mixed impression:

- Some of the consortia showed very good examples of cross-disciplinary collaboration, especially the FC-ICT, ITCEE and QUALITY consortium. They had a clear strategy, frequent consortia meetings (sometimes weekly), and a large portion and number of jointly written publications.
- The panel also found examples where collaboration between the often discipline-specific projects in the consortia was weak and with very little evidence of cross-disciplinary activities.

5.1.2 International Collaboration

The overall impression of collaboration activities with international researchers in the KITARA consortia was also mixed. Most consortia reported very few activities with a few exceptions, e.g., EMPRONET and to some extent REALISE and FC-ICT. The overall number of months spent by KITARA funded researchers at international institutions was quite low. Moreover, awareness of the international state-of-the-art appeared low. Sections 3 (Scientific quality) and 6 (Documentation) both make recommendations to address these points.

5.1.3 Collaboration with Industry

Collaboration with industry varied depending on project objectives. Some of the consortia reported on extensive links to industry and success stories of bringing basic research findings into applications ready to be implemented while others complained about the relevance of the KITARA programme from the perspective of industrial R&D. The panel felt that the annual seminar programme had a possible role in this area. This is discussed in more detail below.

5.2 The Seminar Programme

The annual seminar programme implemented in the KITARA programme gathered programme participants and invited speakers in a two-day event presenting and discussing the different projects. The panel notes the good involvement of PhD students in these seminars, who found these events to be of value in training of communication capabilities and also expanding their professional network. However, the panel notes that some concerns were raised about a lack of involvement from professors, and also a lack of industrial partners. Also, from a collaboration perspective, the seminars could have included smaller and more focused break-out workshops to involve more senior researchers and industrial partners in these events. Part of the two-day event could have been developed to widen participation by inviting relevant industrial partners, the media and other stakeholders in discussions of the applicability of different research findings.

5.3 General Recommendations

With more and more of the important problems at the intersection of disciplines, it is particularly important that the Academy fosters multi-disciplinary and inter-disciplinary collaborations. Plans for these collaborations should be requested at the time of application and funding should be set aside by consortia for effective collaboration activities, that go beyond progress meetings.

The panel recommends that mid-term progress reviews (see Section 2) pay particular attention to collaboration. This is because the panel saw a strong correlation between deep collaboration and high-quality outcomes and outputs of consortia. Continued funding of consortia could, in part, be made dependent on the level of collaboration achieved in the first half of a project.

Finally, the panel suggests that collaboration (especially internationally) could also be made more effective by the greater use of ICT tools, as noted in Section 2.2.

6 Documentation & Reporting

This section contains observations and associated recommendations on the documentation and reporting produced by the individual projects and the programme as a whole.

6.1 Material Provided to the Panel

The material supplied to the panel consisted of a wide range of documents, totalling 4277 pages of information, including various reports, self-evaluation assessments, publications and other products of the programme, as detailed in Appendix C. The panel felt that an assessment of the quality and appropriateness of the documentation fell into the panel's remit. Therefore, this section evaluates the supplied documentation in terms of completeness, structure and organisation, usefulness to the panel and usefulness to the Academy and a wider audience (as perceived by the evaluation panel).

However, it is first noted that the documentation from the majority of consortia was incomplete in some way, with a significant number of final reports and self-evaluation forms apparently not submitted in some consortia.

6.2 Quality of Documentation

These comments and associated recommendations are grouped into three areas for clarity: the funding proposals, in-project reporting and post-project reporting.

6.2.1 Proposals

Whilst some proposals were very good, some appeared unfocussed, with an inconsistent format, and lacking essential elements. For example, several lacked a clear description of the aims and objectives and how the project proposed to address them. This made it difficult for the evaluation panel (and presumably the Academy) to determine whether the original aims of the project had been fulfilled. Whilst it is recognised that different calls will have specific areas that must be addressed by the proposal (such as multi-disciplinary collaboration in the case of KITARA), it is recommended that more consistency be encouraged through a combination of proposal templates and enhanced guidance. As well as clearly addressing specific aspects of a call (such as the integration of ICT), proposals should contain the following:

1. A brief description of the project background
2. A comprehensive review of the international state of the art and how the project aims to move beyond it
3. The overall research question(s) to be addressed and how this relates to the objectives of the wider programme

4. Specific, measurable aims and objectives with a clear statement of the proposed methodology to achieve them
5. A statement on how doctoral training will be supported and what tasks may be suitable for students to undertake
6. A project plan in the form of a Gantt chart or similar format, emphasising links between work packages and critical milestones or other events and clear and concise deliverables.
7. Some treatment of risk with respect to critical resources, people, technologies and milestones.

6.2.2 In-project Reporting

Again, the documentation in the form of annual reports was somewhat mixed. While there were some notably good examples (e.g. the FC-ICT consortium), many were in an inconsistent format, were missing data and, crucially, included no benchmarking against the original plan.

It was also noted from the programme manager that the Academy may not be informed when people retire or move on – all they see is missing reports. It is therefore recommended that a mechanism for this information to be provided to the Academy is implemented.

6.2.3 Post-project Reporting

Post-project reporting took the form of final reports, and self-evaluations, both completed by each funded member of the consortium (and others in the case of 'Form 2' of the self-evaluations, covering topics such as perceived strengths, weaknesses and possible next steps).

It is noted that the fact that the final reports were in the form of completed templates made them more consistent and therefore quicker and easier to digest information from the various projects, although the effort put into filling them in varied widely between consortia. Additionally, each work package leader producing a separate final report led to significant duplication of effort.

It is therefore recommended that the final report should be made jointly by the overall project manager or principal investigator (see also recommendations for an overall project manager and in Section 2) and that a short 'final impact report' aimed at wide dissemination is produced.

Similarly, the panel found that the self-evaluations provided useful material, although again found a wide variation in the effort taken to fill them in. Summarising the key questions from these self-evaluations (Appendix G) reveals that most project leaders and researchers felt they achieved their objectives 'excellently' or 'well', the programme was well managed and that the Academy funding was in most cases essential to the research. This is a very positive outcome.

The panel therefore recommends that the self-evaluations are retained, and indeed, their importance as part of the evaluation process is emphasised, by providing clear guidance in the importance of the self-reflections they contain, for both the researcher also the Academy. For this reason, it is also suggested that the self-evaluations be made anonymous.

Finally, the panel was somewhat surprised that collection of core data and statistics (such as the number of PhD's, the amount of publications and the impact factors of the journals in which they are published, etc.) is not currently performed routinely. It is strongly recommended that this basic information (and also anonymised information from the self-evaluations) is collated and made available in a succinct form to the steering group throughout the programme (to help monitor progress against plans) and also afterwards to the evaluation panel.

On a similar theme, the panel also recommends that the Academy should consider characterising projects by Technology Readiness Levels (TRL's – see Appendix H) for planning and evaluation. For example, this metric could be used to provide a common language to characterise funding applications as basic or applied, or demonstrate how future work could increase or exploit the TRL in a particular area.

6.3 General Recommendations

The panel has made a number of specific recommendations associated with the documentation and reporting for various activities, the underlying philosophy being that "less can frequently be more". As well as the specific points raised above, a suggested reporting structure (related to the recommendations given in Section 2) is shown in Figure 2 below:

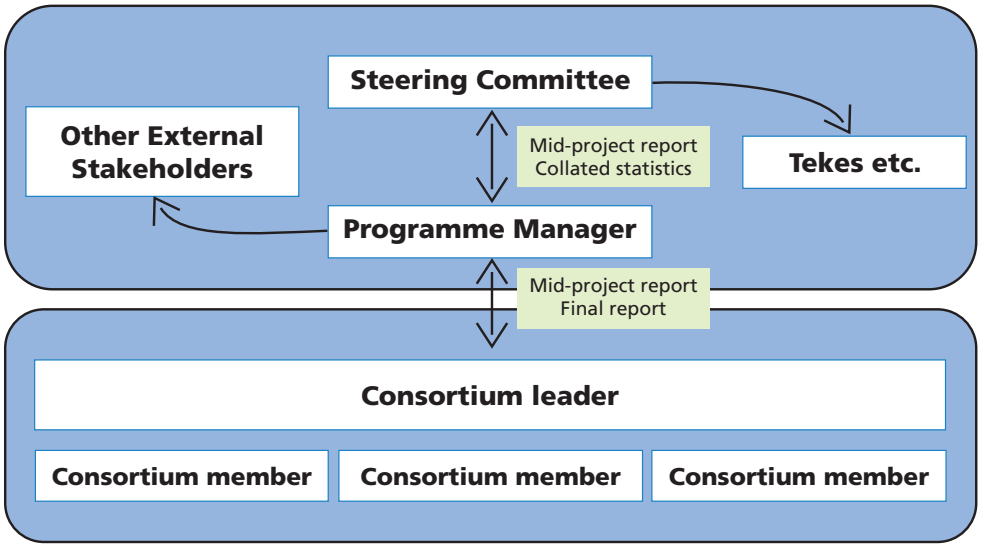


Figure 2. Recommended Reporting Structure

7 Conclusions & Overall Recommendations

The "Application of Information Technology in Mechanical, Civil and Automation Engineering" (KITARA) programme has been successful in achieving most of its key objectives, namely increasing the scientific level and promoting basic research. The panel members were delighted to hear, almost by accident, of the success of KITARA groups/researchers in follow-on research.

The programme also established in a number of beneficial ways some cross-disciplinary groups and collaborations. There were good examples also of potential significant benefits to industry. It is up to industry to leverage this potential to provide actual benefits.

However, in two aspects, the programme did not deliver: The examples of international collaboration or even awareness of international state of the art were patchy. Also there seemed to have been no improvement in the training and monitoring of PhD students as particularly highlighted in the KITARA call and very strongly in the 2007 review of Mechanical Engineering Research in Finland.

7.1 Overall Recommendations

In addition to the specific comments and associated recommendations made throughout this report, the panel wishes to emphasise the following overall recommendations:

1. **New programme** – The Academy should promote another focussed cross-disciplinary, consortia-based call. Possible topics reflecting current trends and the particular areas of expertise of the KITARA consortia and Finland in general are listed in Section 7.2.
2. **PhD training** – This issue does not seem to have been addressed. Is it a University or an Academy issue? The panel noted the rather disappointing number of PhD theses. It is recommended that a PhD training programme is a requirement to be submitted before Academy funding. Examples are given in Appendix F.
3. **International links** – Although these cannot be forced, an awareness of the international State of the Art (SOA) should be a requirement of the funding application (see Section 6)
4. **Monitoring** – Formal mid-project reviews should be considered, possibly replacing annual reports. Thus the model might be submission, mid project review, final report. This would be easier for the academics and the Academy (and the review panel).
5. **A single project leader** – This is suggested for collaborative project. This leader would be responsible for coordination, responding to changing circumstances and producing a single overall report and statistics. (This could be part of the funding profile.)

6. **Documentation and statistics** – This needs considerable attention, it needs regularising and monitoring so that projects can be compared and international comparisons can be considered.
7. **Supporting collaboration** – As a consideration, the panel saw the potential for the greater use of ICT and creating sub-groups on the areas or on the four subject areas (see Appendix B), to get even more benefit from the excellent seminar programme. The evaluation reports were a little equivocal on this.
8. **Technology Readiness Levels (TRLs)** – Although not directly emerging from the evaluation, the panel considered that the use of Technology Readiness Levels (TRLs – see Appendix E) would be useful throughout the Academy in monitoring their programmes and understanding the progression and differences between Tekes and Academy projects.

7.2 Future Research Areas

The panel brainstormed a number of potential future research areas on the basis of their expertise, the KITARA vision and types of projects that had been seen on the KITARA programme, important global challenges, and the unique strengths of Finnish industry and academia. These ideas were analysed and the most promising areas were selected. They are summarised below for consideration by the Academy and Tekes for future programmes.

Since the KITARA program provided a major stimulus to create a world-class, multi-disciplinary research culture in Finland, the suggestions for follow-on research listed below build on this initial stimulus to further enhance the knowledge base for the holistic and integrated production of physical artefacts (or products, such as consumer products, buildings, and large-scale infrastructure) with a life-cycle perspective based on economic, environmental, and social concerns.

Broadly speaking, the panel saw significant opportunities for the creation of the knowledge base needed to create physical artefacts (from consumer products to large-scale infrastructure) in more sustainable ways that leverages the strong foundation Finland has in design, manufacturing, and construction, responds to the most important global trends, challenges, and opportunities, helps create the foundation for a more productive and sustainable Finland and for continued global competitive advantage by Finnish enterprises, and offers exciting career opportunities for Finnish students.

Hence, the suggested topics would form a natural follow-on to KITARA, taking the research communities further into areas to support complex, multi-facetted engineered systems, which is the area with the most interesting and important challenges and opportunities:

1. **Product/service shift/purchasing/supplying capability:** *"Product as a service"* is possibly the most promising shift in thinking about physical products in terms of offering products with dramatically better life-cycle performance for a better cost than the current focus on owning assets. Product as a service enables service providers to bring the latest innovations to market much more easily than is possible today, because a product as a service company owns the entire life-cycle

and supply chain of a product. This new focus on life-cycle fosters *"cradle-to-cradle"* thinking with inherently sustainable technical and biological life-cycles of products and overcomes the current fragmented ownership of physical goods and assets that leads to massive amounts of waste and a cradle-to-grave approach to product lifecycle management that is simply no longer sustainable in the 21st century. A new knowledge base from methods for cradle-to-cradle supply chain management to information systems and accounting methods is needed for economies that see products as services (e.g., where a roofing company owns the roof of a house and the home owner pays this company for the services the roof provides, such as keeping the water out, providing a comfortable indoor climates, etc.).

2. **Whole life knowledge and information management**, which may consider such things as retaining design/manufacturing knowledge and secrecy, distributed resources (operational and physical): New knowledge is needed to understand the lifecycle performance of the physical artefacts used in society and to create easy-to-learn and easy-to-use models to enable product and project teams to predict, visualize, and achieve a particular performance for a product. In addition, new knowledge and methods are needed to combine the advantages of distributed production with the advantages of centralized production.
3. **Concurrent product/process design for civil engineering**, including design automation, lifecycle value, adjusting design and supply chain visibility: Products designed and built by civil engineers have particular importance for society because they represent the vast majority of the fixed physical assets of a society and they enable citizens to work and enjoy themselves. However, because of their unique nature and large scale, their design, construction, and operation tends to be quite wasteful. Manufacturing has seen dramatic benefits from concurrent product and process design. Hence, this suggested area of research focus would create the theoretically sound methods for concurrent product and process design.
4. **Integrated mechanical products/systems for civil engineering with digital control for energy efficiency:** Energy performance of physical artefacts is a particularly important and challenging area for improvement. As energy costs rise and as the impacts of high energy consumptions are felt globally, dramatically better energy performance of physical artefacts is no longer just 'nice to have' but essential for a product that is economically and environmentally competitive. However, because energy performance is affected by many systems of a physical artefact (e.g., for a building it depends on the thermal mass, the façade, the HVAC system, etc. of the building), for most physical artefacts, the computational models and design and management methods to predict and achieve energy efficient production and use of products reliably and to validate the predicted performance against actual performance are in their infancy. Hence, significant scientific advancements are needed to create the fundamental theory for a society that produces and uses its physical things with a dramatically lower energy footprint.

5. **Mechatronic devices in mobile applications**, such as all electric foundry/digger/mining equipment: Significant opportunities to make the large-scale production of high-value adding and high-value goods safer, more productive, and more sustainable through mechatronic, mobile devices.
6. **Overall sensor networks for complex systems (need sensors, ICT to communicate, IT to monitor, interpret and validate):** Our ability to sense our environment and the 'things' we care about in it has been exploding in the last few years. Yet, our ability to set up, maintain, and leverage sensor networks that are appropriate (from the standpoints of economic performance, maintenance, reliability, etc.) and to leverage the data produced by these networks has not increased nearly as fast as the ability to sense performance. The panel see an exciting opportunity to build on some of the KITARA research and create the knowledge to leverage existing sensors in much richer ways than possible today and to help create and update a roadmap for further sensor development.

Appendix A.
Table of Projects, People and Funding

Table A1. Academy funded KITARA Projects, People and Funding

Academy Decision Number	Names of Project Leaders	Funding (EUR)	Project Name	Σ Funding (EUR)	Funding Applied for (EUR)	Comments
211930	Jokela Timo	128,400	DAMEX		**408,500**	
211931	Pakanen Jouko	128,400	DAMEX			
211932	Vähä Pentti	193,800	DAMEX	**450,600**	**110%**	Applied for 408,500 EUR
212038	Malinen Pekka	62,000	DESNET		**NA**	Amount applied for not available
NA	Häkkinen Tarja		DESNET			
NA	Siltanen Pekka		DESNET	**170,800**		**Inc. 108,800 EUR from Ministry of Environment**
107890	Jämsä-Jounela Sirkka-Liisa	342,400	EMPRONET		**1,109,325**	
108067	Kortela Urpo	171,200	EMPRONET			
108005	Lautala Pentti	320,000	EMPRONET	**833,600**	**75%**	Applied for 1,109,325 EUR
211976	Ekman Kalevi	251,670	FC-ICT		**NA**	Amount applied for not available
211978	Nieminen Marko	333,000	FC-ICT			
211975	Orkas Juhani	372,000	FC-ICT	**956,670**		
211808	Hirvonen Juhani	86,500	KOVERA		**606,985**	
211806	Juhala Matti	171,200	KOVERA			
211807	Koskinen Kari	171,200	KOVERA	**428,900**	**71%**	
211967	Hyyppä Juha	128,400	QUALITY		**NA**	Amount applied for not available
211969	Vermeer Martin	115,430	QUALITY			
NA	Jokinen Olli		QUALITY			
NA	Kanerva Pekka		QUALITY	**535,030**		**Inc. 291,200 EUR from Ministry of Environment**
108110	Kankainen Jouko	128,400	REALISE		**688,102**	
108098	Järvenpää Eila	256,800	REALISE			
108008	Sulonen Reijo	256,800	REALISE	**642,000**	**93%**	
211651	Heikkilä Janne	135,000	SIRO		**600,500**	
211652	Myllylä Risto	148,000	SIRO			
211653	Nevala Kalervo	167,500	SIRO			
211650	Sallinen Mikko	150,000	SIRO	**600,500**	**100%**	
211963	Chen Ruizhi	137,000	TRANSPORTATION DATA		**NA**	Amount applied for not available
211964	Haggrén Henrik	137,000	TRANSPORTATION DATA			
211962	Hyyppä Juha	137,000	TRANSPORTATION DATA			
211961	Ernvall Timo	182,000	TRANSPORTATION DATA	**593,000**		
212181	Koskinen Kari	387,800	WATER HYDRAULIC MOBILE		**845,500**	
212182	Mäntylä Tapio	172,100	WATER HYDRAULIC MOBILE			
212183	Pietola Matti	184,000	WATER HYDRAULIC MOBILE	**743,900**	**88%**	
	TOTALS (EUR)	**5,555,000**		**5,955,000**		

Appendix B. Panel's Classification of Projects Against KITARA Focus Areas

Table B1. Panel's Classification of Projects Against KITARA Focus Areas

Original Focus Area	Projects Operating Mainly in this Area
ICT's that support design, manufacturing and re-use (3)	QUALITY – Use of ICT 3D measuring techniques for high quality construction
	TIMARA – Data model automation in reparation and construction of the paved road network
	4DLIVE – Virtual camera systems in 4D modelling in construction
ICT's incorporated in the product (6)	EMPRONET – Embedded control and monitoring systems in production machine networks
	KOVERA – Development process for networked control systems in a mobile working Machine
	Water hydraulic mobile machines with intelligent condition control
	SIRO – MRI-combatable surgical robot
	ITCEE – Transients and efficiency control in digital hydraulics
	TACVISION – Combining image and touch data in robotics
Lifecycle management and its networking in business companies and systems (5)	DAMEX – Data management and exploitation during the use of a facility
	DESNET v Potentials of networking in the application of ICT solutions for life cycle
	REALISE – ICT as an enabler for conversion of real estate business to customer focused workplace industry
	FC-ICT – ICT Support for the renewing business and service concepts of foundry industry
	FOUNDIT – Introduction of internet-based cooperation techniques in construction
ICT's that support interaction between users and building/ machine and the changing environment of use (2)	QUALITY – Use of ICT 3D measuring techniques for high quality construction*
	Transportation data acquisition by means of ICT-derived 3D modelling

** Also classified under ICT's that support design, manufacturing and re-use.*

Appendix C.
Summary of Documentation Provided to the Panel

The documentation provided to the panel by each of the Academy funded projects is summarised below. Note that the majority of consortia appear not to have submitted a complete set of documentation:

Table C1. Summary of Documentation Received by Panel

Project	Annual Reports	Final Reports	Self-Evaluations		Notes
			Form 1	Form 2	
DAMEX	2005- 8 (4)	2	1	3	
DESNET	2005-6 (2)	1	1	1	
REALISE	2005-7 (3)	1	0	0	No self-evaluations
QUALITY	2005-8 (4)	2	2	4	
TRANSPORTATION DATA	2005-7 (3)	4	0	0	No self-evaluations
EMPORONET	2005-8 (4)	2	3	6	
KOVERA	2005-8 (4)	3	1	4	
WATER HYDRAULIC	2005-7 (3)	1	2	2	
SIRO	2005-8 (4)	4	4	11	This appears complete
FC-ICT	2005-7 (3)	2	2	6	Additional final report of own design (very good)

Appendix D.
Evaluation Panel Agenda and List of Interviewees

Table B1 records the people who were interviewed by the evaluation panel:

Table D1. People Interviewed by the Evaluation Panel

Project	Person	Role
Academy of Finland	Dr. S Karvinen	KITARA Programme Manager
	E. Aalto	Member of KITARA steering group
	H. Hänninen	Chair of KITARA steering group
Tekes	T. Laurila	Member of Tekes Steering group
Ministry of the Environment	J-P. Maijala	
QUALITY	O. Jokinen	Project Leaders
	J. Hyyppä	
	M. Vermeer	
SIRO	J.Heikkilä	Project Leaders
	R. Myllylä	
	M.Sallinen	
ITCEE	M.Pietola	Project Leaders
	M. Linjama	
	M. Walden	
DAMEX	J. Pakanen	Consortium Leader
KOVERA	O. Kaijalainen	PhD Students
	J. Peltola	
FC-ICT	P. Makkonen	Researcher

The Agenda of the Evaluation panel is shown below:

Date: **14–15 June, 2010**

Work schedule

Place: **Academy of Finland, Helsinki** (Vilhonvuorenkatu 6, meeting room 205)

Hosts: **Programme Manager Dr. Saila Karvinen**
Senior Science Advisor Ritva Taurio
Ms Hanna-Kaisa Haaksi

Monday 14 June, 2010

09:00–10:00	Kick-off of the panel meeting
	Introductions of the panel members and the Academy of Finland staff, Dr. Arja Kallio, Director, Programme Unit
	Presentation of the Academy of Finland, Dr. Arja Kallio, Director, Programme Unit
	Presentation of the research programme KITARA and the evaluation process, Dr. Saila Karvinen, KITARA Programme Manager
10:00–11:00	Interview: Programme Manager
11:00–11:20	Interview: Timo Laurila, Tekes, Steering Group
11:20–11:40	Interview: J-P. Maijala Ministry of Environment, Steering Group
11:40–12:00	Interview: E. Aalto , Steering group
12:00–13:00	Lunch
13:00–13:30	Interview: O. Jokinen, J. Hyyppä, M. Vermeer, QUALITY-consortium
13:30–14:00	Interview: J.Heikkilä, R. Myllylä, M.Sallinen, SIRO-consortium
14:00–14:30	Interview: M.Pietola, M. Linjama, M. Walden, ITCEE-consortium
14:30–15:00	Coffee break
15:00–15:20	Interview: Jouko Pakanen, Damex consortium leader
15:20–15:40	Interview: Osku Kaijalainen, Jukka Peltola PhD students KOVERA consortium
15:40–16:00	Interview: Petri Makkonen, researcher FC-ICT consortium
16:00–18:00	Summary of day one, drafting of the Evaluation Report

Tuesday 15 June, 2010

08:30	Meeting in the hotel lobby, by metro to the Academy of Finland
09:00–09:45	Interview: Hannu Hänninen, chair of the steering group
09:45–11:30	Panel work, writing of the Evaluation Report
12:30–13:30	Lunch
13:30–15:00	Panel work, writing of the Evaluation Report
15:00–16:00	Summary of the panel and feedback to the Academy of Finland; agree on the delivery of the evaluation report

Appendix E.
Members of the KITARA Steering Group

2004–2006

Professor *Hannu Hänninen* (chair), Research Council for Natural Sciences and Engineering

Professor *Kaisa Sere* (vice chair), Research Council for Natural Sciences and Engineering

Professor *Kirsti Loukola-Ruskeeniemi*, Research Council for Natural Sciences and Engineering

Director *Jukka Pekkanen*, Confederation of Finnish Construction Industries RT

Managing Director *Juhani Reen*, RAKLI (The Finnish Association of Building Owners and Construction Clients)

Director of Development *Helena Säteri*, Department of Built Environment, Ministry of Environment

2007–2010

Professor *Hannu Hänninen* (chair), Research Council for Natural Sciences and Engineering

Professor *Kaisa Sere* (vice chair), Research Council for Natural Sciences and Engineering

Professor *Helena Aksela*, Research Council for Natural Sciences and Engineering

Technology Manager *Timo Laurila*, Tekes

Director *Jukka Pekkanen*, Confederation of Finnish Construction Industries RT

Development Director *Erkki Aalto*, RAKLI (The Finnish Association of Building Owners and Construction Clients)

Director General *Helena Säteri*, Department of Built Environment, Ministry of Environment

2010

Professor *Helena Aksela*, Research Council for Natural Sciences and Engineering, (chair)

Professor *Riitta Kyrki-Rajamäki*, Research Council for Natural Sciences and Engineering (vice chair)

Technology Manager *Timo Laurila*, Tekes

Director *Jukka Pekkanen*, Confederation of Finnish Construction Industries RT

Development Director *Erkki Aalto*, RAKLI (The Finnish Association of Building Owners and Construction Clients)

Director General *Helena Säteri*, Department of Built Environment, Ministry of Environment

Professor *Hannu Hänninen*, Aalto University

Appendix F.
Partial List of Degrees Produced and Example PhD Processes

Note: This is a partial list compiled from the Academy's online system, and therefore the number of theses below do not match the numbers given in Table 1 (Section 4), which was supplimented by other sources of documentation from the projects (such as the annual and final reports).

PhD THESES

FC-ICT – Kotinurmi, P. , EBusiness Framework Enabled B2B Integration. Dissertation for the degree of Doctor of Science in Technology at Helsinki University of Technology TKK. 2007.

EMPRONET – Tiina Komulainen (2007), Novel modeling and control approach for performance improvement of an industrial copper solvent extraction process, PhD thesis, Aalto University

EMPRONET – Mikko Vermasvuori (2008), Methodology for utilising prior knowledge in constructing data-based process monitoring systems with an application to a dearomatisation process, PhD thesis, Aalto University

EMPRONET – Ismo Laukkanen (2008), Knowledge transfer and competence development in complex paper production environments, PhD thesis, Aalto University

EMPRONET – Hui Cheng (2009), Causal digraph reasoning for fault diagnosis in paper making applications, PhD thesis, Aalto University

EMPRONET – Markus Kettunen (2010), Data based fault tolerant MPC for a complex dearomatization process, PhD thesis, Aalto University, (dissertation date 4th of June 1020)

EMPRONET – Leppäkoski, K. (2006). Utilisation of non-linear modeling methods in flue-gas oxygen-content control. Doctoral thesis, Department of Process and Environmental Engineering, University of Oulu, Oulu, Finland

SIRO – Virtanen J., Enhancing the compatibility of surgical robots with magnetic resonance imaging, Doctoral thesis, University of Oulu, 26.5.2006

LICENTIATE THESES

EMPRONET – Tervaskanto Manne (2006). Performance indexes for monitoring of pulping processes. Licentiate thesis, Department of Process and Environmental Engineering, University of Oulu, Finland

QUALITY – Kaartinen, H., Evaluation of Building Extraction Methods on Airborne Laser Scanning and Aerial Images, Licentiate Thesis, TKK, 2007

SIRO – Heimonen T (2007) Computer vision based pose estimation and tracking of a magnetic resonance imaging compatible robot - a feasibility study. Licentiate thesis, Department of Electrical and Information Engineering, University of Oulu, Finland

SIRO – Harja J. M. Case studies of magnetic resonance imaging compatible fibre optic measurement devices. University of Oulu, Department of Electrical and Information Engineering. Licentiate Thesis

MASTERS THESES

Water hydraulic mobile – Saarinen, M. 2007. Water Hydraulic Realization of Mobile Machines Work Hydraulic and Pump Control. MSc thesis. Tampere, Finland. Tampere University of Technology. Institute of Hydraulics and Automation

Water hydraulic mobile – Perukangas, M. 2009. Control and condition monitoring system of a water hydraulic mobile machine. MSc thesis. Tampere, Finland. Tampere University of Technology. Department of Intelligent Hydraulics and Automation

Water hydraulic mobile – Pietikäinen, J. 2010. Position Control in Condition Monitoring of Water Hydraulic Proportional Valve. MSc thesis. Tampere, Finland. Tampere University of Technology. Department of Intelligent Hydraulics and Automation

FC-ICT – CastillonSolano, M.O. Survey and Analysis of Sand Casting Design Methods. Master's Thesis, Helsinki University of Technology, 2006. Supervisor prof. Juhani Orkas

FC-ICT – Saarelainen, T. Development Process of a Cast Component. Master's Thesis, Helsinki University of Technology, 2006.Supervisor prof. Juhani Orkas

EMPRONET – Juan José Andrade Negrete (2009), Fault Diagnosis Scenario for the Lubricating System of a Cone Crusher, MSc Thesis, Aalto University

EMPRONET – Vesa-Matti Tikkala (2008), Fault Diagnosis of a Board Machine Based on Causal Digraph Method. MSc Thesis, Aalto University

EMPRONET – Di Zhang, (2008), Plant-wide disturbance detection and diagnosis, MSc Thesis, Aalto University

SIRO – Harja J. M. (2006) Magnetic resonance imaging compatible three degrees of freedom joystick. Department of Electrical and Information Engineering, University of Oulu, Finland. Master's Thesis

SIRO – Juola M. (2006), Enhancements of fibre optic sensors compatible for magnetic resonance imaging environment. University of Oulu, Department of Electrical and Information Engineering. Master's Thesis

SIRO – Jaara, J., Designing surgical robot for clinical MRimaging environment. University of Oulu, Department of Mechanical Engineering. Master's thesis 2007

SIRO – Junttila P., Control of MRI-compatible robot in MRI environment, University of Oulu, Department of Mechanical Engineering, Master's thesis 2007

SIRO – Tikkanen J. (2006), Fibre optic angle sensor. University of Oulu, Department of Electrical and Information Engineering. Diploma Thesis

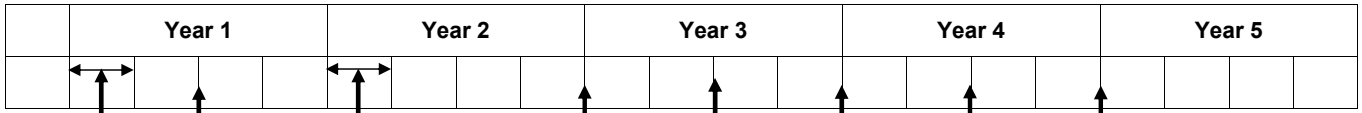
DAMEX – Helander, Johannes, 2006. FLASH-muistien hyödyntäminen taloteknisten järjestelmien ohjauksessa,Diplomityö, TKK/Automaatio- ja systeemitekniikan osasto

EXAMPLE PhD GUIDELINES

Example guidelines for PhD Students from Stanford University (USA) may be found at:

http://cee.stanford.edu/programs/construction/considering/phd.html. The University of Bath (UK) also has a clearly defined series of steps for progression as part of a comprehensive handbook defining training requirements etc. which may be accessed at: http://www.bath.ac.uk/mech-eng/postgraduate/current/pgr-handbook.pdf. The timeline for progression and the requirements at the University of Bath at each stage are reproduced overleaf:

Progression Diagram for a Full-Time MPhil/PhD Postgraduate



Candidature Form to be completed by supervisors/student, within 1 month of registration

* Any application for restriction of access to a thesis should be made at this stage

6m Progress Report to be completed by supervisors

MPhil/PhD Transfer, normally at 12 months:

1. Student submits Transfer Report
2. Viva conducted by impartial transfer panel (2)
3. Assessors complete PGR3 & Transfer Feedback form with recommendation supported by Certificate of Attendance from PG Skills Training site.

The transfer report replaces 12 m Progress report for all FT students if completed on schedule.

24m Progress Report to be completed by supervisors to include training undertaken in review period

30m Progress Report to include a contents list of thesis, identifying chapters complete to demonstrate tangible progress in writing up

36m Progress Report to be completed by supervisors to include further training

42m Progress Report to be completed by supervisors

Transfer to Writing-Up mode form, 36 months, to be completed by supervisors*

* If the supervisors do not complete this, the student is assumed to remain under full-time registration and is invoiced by the University for **full fees**

Extension of Registration form, 48 months, completed by supervisors

PhD Examination, 24 – 60 months:

1. Student submits 'intention to submit' form HD1 to Graduate Office
2. Supervisors nominate internal/external examiners to Faculty BoS for approval *
3. Student submits 3 soft bound copies of thesis to Graduate Office
4. Department sends Thesis/Examiners' Forms to Examiners
5. Pre-viva report forms to be submitted to Director of Postgraduate Studies 7 days before viva
6. viva examination/recommendation form
7. The viva should take place within 3 months of thesis submission
8. Supervisors to be present with student when examiners deliver outcome after viva
9. SAMIS updated to reflect recommendation of the Examiners
10. Recommendation of the Examiners to the Faculty BoS
11. Written confirmation of the decision of the BoS

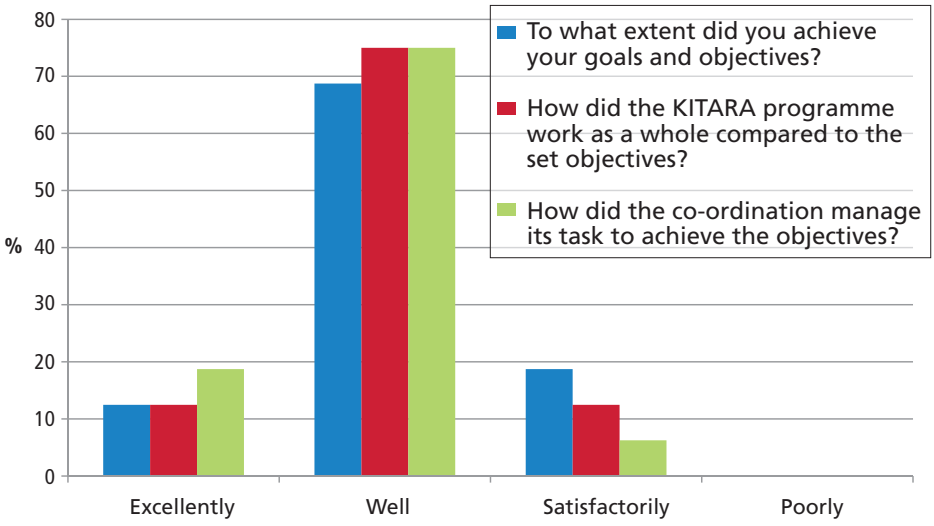
* Supervisors/student should not communicate with examiners after their appointment

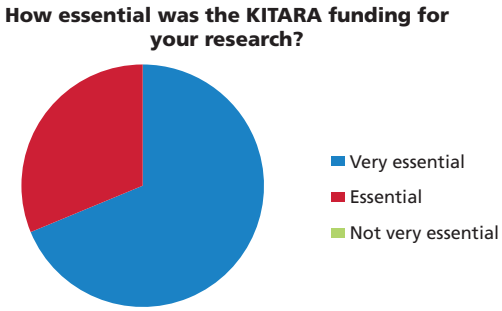
Version 0910a Mar 2010

Appendix G.
Self-Evaluation Forms and Summary Statistics

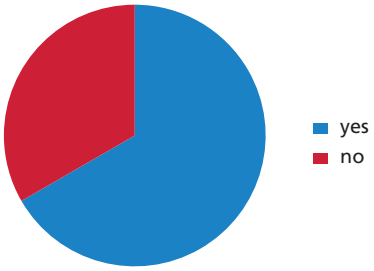
This Appendix first shows summary statistics from key self-evaluation questions. The full self-evaluation forms sent to project members (project leaders received Form 1, researchers and students received Form 2) are then also reproduced. The instructions originally sent out with the forms are also included:

Project Leader Responses

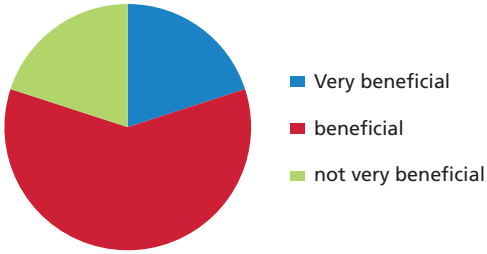




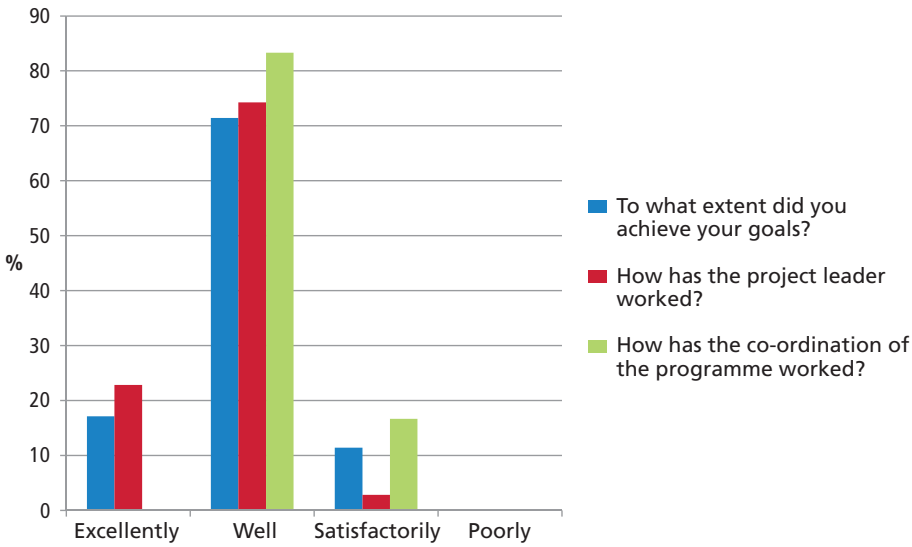
Did the project receive the funding that was applied for?



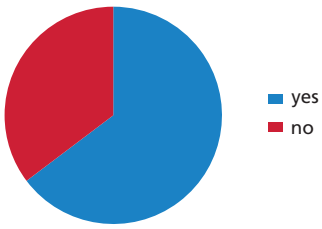
How beneficial has participation in the KITARA programme been to your research if NOT considering the direct funding?



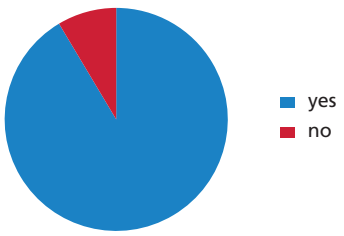
Researcher/Student Responses



Did the programme generate co-operation with researchers from Finland/other countries that you would not have had without this funding?



Was the funding made available to your part of the project appropriate in terms of your research plan?



Dear KITARA Project Leader,

It is now time to prepare ourselves for the evaluation of **KITARA Programme**. This is a task for us all, every single one of us is involved.

Attached you will find two forms:

FORM 1 is for you Project Leaders to complete

FORM 2, which you are asked to give to those students/researchers to complete, who have been funded fully or partly by KITARA funding.

Please send the forms as an e-mail attachment **by 15.02 2009** to saila.karvinen@aka.fi (For any technical questions, please, contact hanna-kaisa.kronstrom@aka.fi).

KITARA is coming to an end, and on the basis of the strategy adopted by the Academy of Finland, it is to be evaluated. It is true that, there are still some research groups, who receive full funding in 2008, and 2009 and others who still have loose ends and unused funds. In the evaluation, all this will be taken into consideration. In future this situation will also be common, as programmes will receive additional funding when the programme instrument will be developed to be more flexible in changing situations. It is generally acknowledged that the impact assessment should be done some time after the programme has ended. The KITARA Steering Group has decided to …….

Background

I kindly ask you to remind yourselves of the reasons for this evaluation by reading Chapter 4 **Evaluation of research programmes: a tool for science policy and the development of research** in Academy of Finland – Research Programme Strategy, pp 64-66, Academy Publication Series 2/03 (www.aka.fi/publications).

A research programmes is a strategic funding instrument in which the funded projects are focused on a defined subject area or set of problems. Research programmes are expected to have added value over funding individual projects. The evaluation process is a tool to assess how well the goals were achieved and a tool to further develop the programme instrument. Besides evaluation of the progress and achievements of individual projects, emphasis is on the evaluation of the programme as a whole.

Evaluating a programme is a lot of work, and a demanding task. We invite top scientist in the field, with wide expertise and understanding of the complexity of the task at hand to carry out the evaluation. What is needed from us is that we fully acknowledge this and *provide them with all necessary information*.

The questionnaires attached (Form 1 and Form 2), which you are asked to complete, are the basis for the evaluation. The evaluators are not mind-readers: they need our full cooperation, and they need good communication from us to be able to fulfil their demanding task. Please do fill in the forms truthfully, thoroughly and with consideration, answering all the questions. As a coordinator, I will prepare a technical summary

report from the information you provide. However, all forms are also sent to the evaluators, all information without filtering will be at their disposal unedited.

To give you an idea of what the evaluation panel is asked to do below is an extract from the invitation letter describing the assignment.

Reporting to funding agencies

This is just to remind you that each project will report to their own funding organisations (Tekes or the Ministry of the Environment) as requested by them, following their own rules. For the Academy *'The funding report shall be submitted to the Academy of Finland no later than 15 June of the year following the last year of project funding'*. The funding period is indicated in the decision letter; to most of you the period ends in December 2008 or December 2009.

An extract from the invitation letter:

The objective of the scientific evaluation is to estimate to which degree the KITARA research programme has succeeded in fulfilling the objectives that have been listed in the Programme Memorandum. Of specific interest are the programmatic approach, added value and programme impacts, interdisciplinarity, applicability of research, networking and dissemination of results.

In the Evaluation Report, the panel is expected to assess the programme as a whole and reflect especially on the following issues:

1 Scientific quality of KITARA
  Scientific quality and innovativeness of the research
  Scientific competence of the consortia
2 Success of the implementation of the programme goals and objectives
  Concordance with the objectives of the research programme
  Functioning of the programme
  Added value of the programme
  Contribution to enhancing inter- and multidisciplinarity in research
  Scientific and administrative co-ordination
3 Contribution to researcher and expert training
4 Collaboration and networking
  Collaboration within the programme
  Collaboration with the other Finnish groups
  International co-operation
  Collaboration with end-users
5 Applicability of research and importance to end-users
  Contribution to promoting the applicability of research results
  Relevance and importance to end-users
  National and international impact of the programme
6 Recommendations for the future (incl. the justification for recommendations)

The work will include examination of the reports, self-evaluation assessments, publications and other products of the programme and discussions with the Programme Steering Group, key stakeholders, researchers and programme coordination during the panel meeting.

'Form 1' for Project Leaders

FORM 1 **Confidential**

(To be completed by KITARA Project Leaders)

KITARA Research Programme (2005–2009) evaluation form

You are kindly asked to answer all the questions, even if negative, in order for us to be sure that there are no omissions.

A summary technical report will be compiled on the basis of the questionnaire.
NOTE that all forms will also be sent to the evaluation panel members.

A. Description of the project

1. Organisation and structure of the project

Project title (and website, if applicable):

_____

Consortium name:

_____

Person(s) in charge:
Name, position, organisation, gender, degree, year of birth

_____

(COPY THIS SECTION WHEN NEEDED)

Research personnel financed (fully/partly) by KITARA funding
Name, department and position, person-- months, gender, degree, year of degree, year of birth

_____

In Section 'Position', the following titles should be used: Professor, Senior Researcher, Post Doc, PhD student/MSc student, other (please specify).

(COPY THIS SECTION WHEN NEEDED)

Research personnel closely related to the KITARA project (but on other funding)
Name, department and position, gender, degree, year of degree, year of birth

_____

2. Degrees completed in the project

Include all degrees

(COPY THIS SECTION WHEN NEEDED)

Name: _____

Basic degree: _____ Gender: Male ❑ Female ❑

Year of earning the above degree: _____ Major subject: _____

University and department (of basic degree): _____

Degree completed within **this project**: _____

University: _____

Department: _____

Year: _____ Major subject: _____

Graduate school (if appropriate): _____

3. Funding

Total KITARA funding (euro) and funding agencies:

A) Funding from the Academy of Finland, the Ministry of the Environment, and the Finnish Funding Agency for Technology and Innovation (Tekes)

B) Other funding (and name of the funding agency) (by calendar year)

Other funding for the project:

a) Funding of the home institution (an estimate, incl. in-kind contribution[1]) (euro)
b) Other external funding (such as university, other national funding, international funding, other)

[1] 'In-kind contribution' means an estimate of the monetary value of resources given in other form than money, for example, working time of the personnel.

	year	2005	2006	2007	2008	2009
A) in KITARA						
B) other/specify	a)					
	b)					

4. The progress of the project and main results

Please describe the aims, the main scientific results and achievements, including the innovativeness (novelty) in comparison to other research in your field. (max 3 pages)

---

5. Multi- and interdisciplinarity of the project

How did multi- and interdisciplinarity become concrete?
(*Multidisciplinarity means that a given set of problems is analysed simultaneously from the vantage point of several different disciplines. Interdisciplinarity implies deeper integration: research will also borrow concepts, methods and perspectives from other disciplines.)*

---

6. What, if any, changes were made to the original research plan?
How did the project follow the research plan and why did the plan have to be changed?

---

7. Drawbacks
What factors, if any, hindered the planned progress of the project?
Were the risks identified at the beginning of the project?

---

8. National and international collaboration and networking of the project
Free text describing your networking. Please specify the nature of collaboration and type of collaboration partners. Specify if the networking has resulted in co-publication or other documented output.

Did the KITARA programme generate co-operation that, you would not have had without this funding?

Do you have collaboration with other KITARA projects, and what is the level of collaboration? Is this collaboration pre-KITARA, or generated by KITARA?

Your links through ICT within the KITARA programme

Your links through mechanical engineering within the KITARA programme

---

Your links through civil engineering within the KITARA programme

---

Your links through automation engineering inside KITARA programme

---

The following forms should be used in describing the activities that have been relevant in the networking of the researchers. 'Other activities' can refer to things such as a working group or an evaluation task, etc.

(COPY THIS SECTION WHEN NEEDED)
Seminar/congress ATTENDED

Title: _____

Organiser(s): _____

Time: _____

Participant(s) from the project: _____

Activity, authors and title (paper, poster, chairmanship, other): _____

Place: _____

(COPY THIS SECTION WHEN NEEDED)

Seminar/congress ORGANIZED BY THE PROJECT

Title: _____

Organiser(s): _____

Time: _____

Participant(s) from the project: _____

Activity, authors and title (paper, poster, chairmanship, other): _____

Place: _____

(COPY THIS SECTION WHEN NEEDED)

National or international visits, duration one week or longer

Type of visit (visiting researcher, teacher, etc): _____

Aim of visit: _____

Host: _____

Time: _____

Participant(s) from the project: _____

(COPY THIS SECTION WHEN NEEDED)

National or international visits HOSTED BY THE PROJECT, duration one week or longer

Type of visit (visiting researcher, teacher, etc): _____

Aim of visit: _____

Visitor: _____

Time: _____

(COPY THIS SECTION WHEN NEEDED)

Other activity

Type of activity: _____

Aim of activity: _____

Activity: _____

Place: _____

Participant(s) from the project: _____

9. Post -graduate training of the personnel

How was post-graduate training in the project organised in general?
What training did the researchers receive and who organised it?
Were the researchers enrolled at a graduate school? If yes, which?
Researcher, name of the graduate school, postal address of the school

_____

10. How did the project promote equality?

_____

B. Self-evaluation

Objectives of KITARA

To strengthen basic research expertise in the fields of mechanical, civil and automation engineering through the application of information and communications technologies

To enhance

- new multidisciplinary research groups
- use of existing information
- synergistic use of resources
- researcher training
- national and international cooperation

To what extent did you achieve your goals and objectives?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

To what extent did your project/activities contribute to the objectives of the programme?

Added value of the consortium (when appropriate) – has working as a consortium advanced the research of your project? How?

How much of the research work has been carried out as team-work between the research groups (sub-projects)?

Applicability of the research results – contribution to practice and decision-making

How could your results be applied and by whom? Identify possible end-users.
Have your research results been used? When, by whom?

Communication of the results

How did/does the project communicate with end-users? Please, specify these end-users.

How does/did the project disseminate the results? Has the results of the KITARA-project been presented or published in any media outside the scientific community? If yes, what media and when? Who initiated the publicity?

How did the KITARA programme work as a whole compared to the set objectives?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

Were the goals relevant and achievable? Other comments?

Coordination and programme management

How did the co-ordination manage its task to achieve the objectives?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

How did your project benefit from the coordination?

Which of the events organised by the coordinator did you found useful and why?

How has your project and its researchers participated in joint programme actions?

How has the participation been reflected in the work of your research group?

What kind of support would your project have required more from the coordination? What did the coordination fail to achieve? Other comments?

Funding

How essential was the KITARA funding for your research?

Very essential ❑ Essential ❑ Not very essential ❑ Not at all important ❑

Did the project receive the funding that was applied for?

Yes ❑ No ❑

Was the funding sufficient compared to the research plan?

Other impacts of funding (positive/negative)

Did the research field gain any added value for having a programme compared to normal research grants? What about your project?

How, if at all, did the programme enhance the development of the research area?

What do you think were the most important gaps in the research area not covered by the KITARA programme?

How beneficial has participation in the KITARA programme been to your research if NOT considering the direct funding?

Very beneficial ❑ Beneficial ❑ Not very beneficial ❑

What did you achieve that could not have been done without the KITARA funding?

Strengths and weaknesses

What are the inner strengths of the KITARA programme?

What were the weaknesses of the KITARA programme?

How could the KITARA programme have been improved?

The future

What are the future possibilities and plans of the research team after KITARA? In terms of funding, completion of studies, employment of the personnel, etc.

In what form do you anticipate the present national/international collaboration of your project to continue?

What new important research topics, if any, did come up?

Recommendations for the future

How would you raise the level of research in your field in Finland?

How would you compare the level of research in your field in Finland to other countries?

What are the greatest shortcomings, problem areas-, and needs in your field of research?

Suggestions for improving future research programmes

Other comments

Appendices

1 A full list of publications and other outcomes of the project (2003 onwards –) presented as shown below.

*Please underline the publications and other outcomes arising from the funding granted by the KITARA programme for **this project**.*

Articles:
1. Scientific articles (reviewed)
2. Other scientific articles
3. Popular articles
4. Submitted manuscripts (indicate status: submitted/accepted).
(Abstracts and manuscripts in preparation are not reported)

Scientific reports

Books or book chapters
Academic theses
Patents
Television and radio programmes
Scientific awards
Other professional documented activities

2 An electronic version- (preferably, if available) of key published scientific papers (max 10 papers/project).

3 One copy of the PhD thesis or the supervisor's assessment and schedule of the completion of each KITARA-funded PhD student (in English)

Please send the form as an e-mail attachment by X August 2008 to saila.karvinen@aka.fi

'Form 2' for Researchers and Students

Dear KITARA Researcher,

You are kindly asked to complete this form. The information to be gathered will serve the evaluation of the KITARA Research Programme. We ask you to fill in the form thoroughly and truthfully. The coordination will prepare a technical summary report from the information you provide. However, all forms, are also sent unedited to the evaluators.

You are asked to answer all questions, even when the answer is negative, for instance: *'How have you participated in joint programme activities?' I have not participated in any of the activities' (comments on why not would be useful to have, too).*

This material together with other KITARA material as well as, the interviews of researchers and stakeholders during the panel meeting-, are the basis for the work of the international evaluation panel. The outcome of the evaluation will be published in autumn 2010. More information on the goals of the evaluation can be found in Chapter 4 **Evaluation of research programmes: a tool for science policy and the development of research** in Academy of Finland – Research Programme Strategy, pp 64-66, Academy Publication Series 2/03 (www.aka.fi/publications)

Please send the form as an e-mail attachment **by xx xxxxx 20xx to saila.karvinen @aka.fi**

If you have any questions, please-, do not hesitate to contact me.

(For any technical questions, please, contact hanna-kaisa.kronstrom@aka.fi).

With kind regards,

Saila

Saila Karvinen
Programme Manager
Saila.Karvinen@aka.fi
358 –9-7748 8335

FORM 2 **Confidential**

(To be completed by those who were/are employed by the KITARA projects --funded fully/partly)

KITARA Research Programme (2005–2009) evaluation

A summary technical report will be compiled on the basis of the questionnaire.

NOTE that all forms will also be sent to the evaluation panel members.

Self-evaluation of the research project and programme

Name of researcher: _____

Name of project: _____

Research field: _____

Period of work in the project: _____

EVALUATION CRITERIA

1. Goals and focus

1.1. What were the goals and focus of your work in the project?

_____

1.2. To what extent did you achieve them?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

Please specify:

_____

2. Scientific standard

2.1. What are the new scientific results achieved by your part of the project?

_____

2.2. Publications (published and to be published, year) connected to this project

Publications in scientific journals, as well as dissemination in any other media

a) National

_____

b) International publications

_____

2.3. Education

a) Did you or will you receive a university degree as a result of the project?

Yes ❑ No ❑

Which degree? MSc ❑ Licentiate ❑ PhD ❑ other, specify ❑ _____

b) How were you employed/will you be employed after the end of the project?

- ❑ Academic research and teaching (same field)
- ❑ Academic research and teaching (different field)
- ❑ Other publicly financed research and development work
- ❑ Teaching outside university
- ❑ Administration work
- ❑ Other, specify
- ❑ No employment

How are you/have you been engaged in non-academic work during or after the project?

- ❑ Have you employment outside academia (specified above)?
- ❑ If not, have you been involved in consultancy work?
- ❑ Have you provided paid or unpaid advice to non-academic organisations?

If yes, to any of the above questions

Please specify the activity.

Have you applied in such work any of the knowledge or skills gained during the KITARA programme? Please specify.

---

3. Co-operation

3.1. How has the project leader worked?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

Comments:

3.2. How has the co-ordination of the programme worked?

Excellently ❑ Well ❑ Satisfactorily ❑ Poorly ❑

Comments:

3.3. How have you participated in joint programme activities?

3.4. How has the participation been reflected in your work?

3.5. Did the programme generate co-operation with researchers from Finland/other countries (which?) that you would not have had without this funding?

Yes ❑ No ❑

Please specify:

3.6. What are the lessons learnt from the co-operation between teams from Finnish and other countries' research environments?

---

4. Project funding

4.1. Describe the project funding you received by calendar year from the following sources:

Funding source: year	2005	2006	2007	2008	2009
KITARA programme					
University					
Other national funding					
(please specify)					
Other international funding					
(please specify)					

4.2. Was the funding made available to your part of the project appropriate in terms of your research plan?

Yes ❑ No ❑

Comments:

---

5. Strengths and weaknesses

a) What were the inner strengths of the KITARA programme?

---

b) What were the weaknesses of the KITARA programme?

---

c) How could the KITARA programme have been improved?

---

6. Recommendations for the future

How would you raise the level of research in your field in Finland?

How would you compare the level of research in your field in Finland to other countries?

---

c) What are the greatest shortcomings, problem areas and needs in your field of research?

---

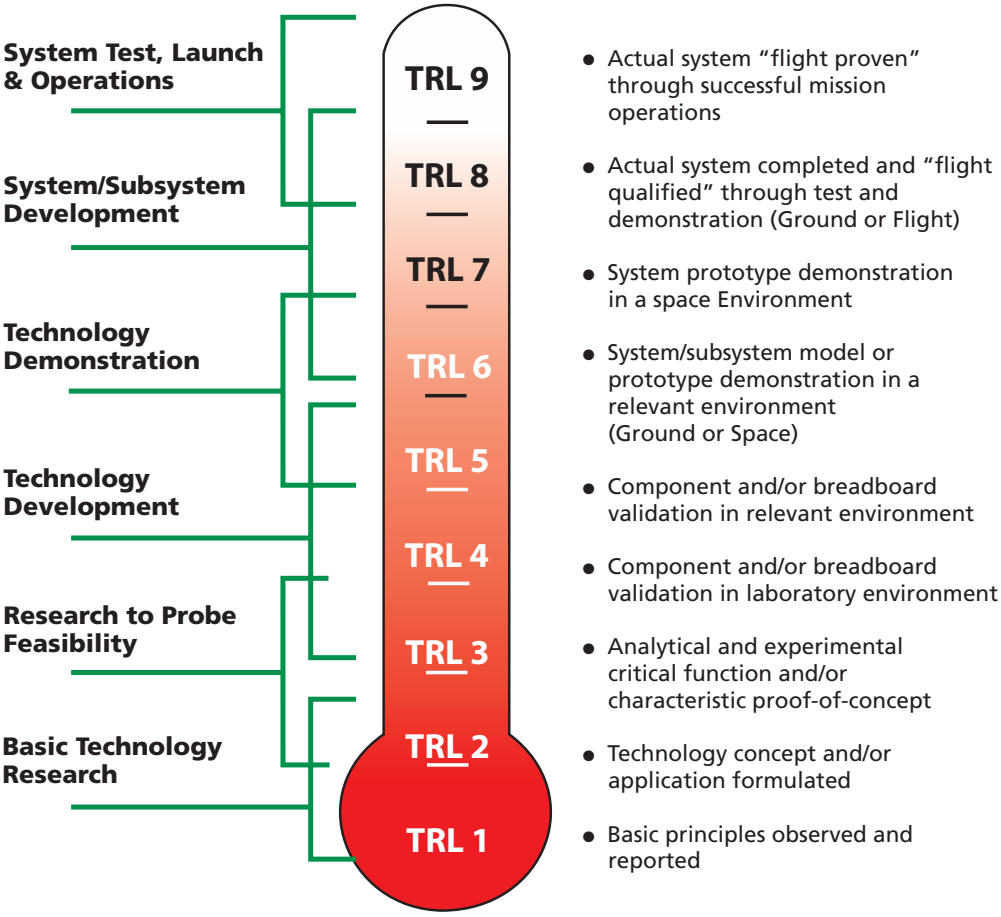
d) Suggestions for improving future research programmes

Appendix H.
Technology Readiness Level

The concept of Technology Readiness Levels (TRL's) are increasingly used by governments and organisations to define with a common language at what level their research/R&D are operating. A commonly used TRL scale is that used by the National Aeronautics and Space Administration (NASA), which is reproduced below (Source: http://www.hq.nasa.gov/office/codeq/trl/trlchrt.pdf):

HRST Technology Assessments

TECHNOLOGY READINESS LEVELS



Panel Members

Chair of the panel

Professor *Stephen Culley*
Head of Design and Manufacturing Group
Department of Mechanical Engineering
Faculty of Engineering Design
University of Bath

Members of the panel

Professor *Thomas Olofsson*
Professor in Construction Engineering and Management
Department of Civil, Mining and Environmental Engineering
Luleå University of Technology

Professor *Martin Fischer*
Professor of Civil and Environmental Engineering (Construction Engineering and Management and Sustainable Design and Construction Programmes)
Director, Center for Integrated Facility Engineering (CIFE)
Coordinator, Building Energy Efficiency Research,
Precourt Energy Efficiency Center (PEEC)
Affiliated Faculty Member of the Woods Institute for the Environment
Affiliated Faculty of the Emmett Interdisciplinary Programme in Environment and Resources (E-IPER)

Scientific secretary

Dr *Hamish McAlpine*
Department of Mechanical Engineering,
University of Bath

The Academy of Finland Research Programme on the Application of Information Technology in Mechanical, Civil and Automation Engineering (KITARA, 2005–2009) was launched in 2005. The specific objective was to strengthen basic research expertise in the field of mechanical, civil and automation engineering through the application of ICTs.

In 2010, the Academy of Finland appointed an international expert panel to evaluate the programme. The panel was asked to assess the programme as a whole, reflecting particularly on the scientific quality of the programme, the success of programme implementation, and its contribution to researcher and expert training. This report includes the results of the evaluation and the recommendations of the panel.

ACADEMY OF FINLAND

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